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ABSTRACT

This Bulletin updates the story of world population presented in 1971, "Man's Population Predicament." Estimated at half a billion in 1650, world population reached 2 billion in 1930, 4 billion in 1975, and is projected to be about 6 billion in 2000. Most of today's rapid growth is occurring among people living in less developed countries where the post-World War II gap between high birth rates and falling death rates has only recently begun to narrow. This growth, coupled with high consumption in developed countries, is putting pressures on the resources, environment, and social fabric of the earth. New evidence on Europe's demographic transition and from China, Indonesia, and Thailand in the 1970s suggests that well-designed family planning programs can speed fertility decline but rapid worldwide attainment of replacement-level fertility will also require special development efforts. Current projections for the world's ultimate peak population range from 8 billion in the mid-21st century to 11 billion about 2125, depending on when replacement-level fertility is reached. China's drive for a drastic birth rate reduction and the oil crisis might change fertility behavior more rapidly than most demographers have heretofore thought likely. Numerous graphs and tables illustrate the report. (Author)

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POPULATION

BULLETIN

OUR POPULATION PREDICAMENT:

A NEW LOOK

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Abstract—Issued to mark the Population Reference Bureau's 50th anniversary, this *Bulletin* updates the story of world population presented in its popular predecessor of 1971, "Man's Population Predicament." Estimated at half a billion in 1650, world population reached 2 billion in 1930, 4 billion in 1975, and is projected to be about 6 billion in 2000. Most of today's rapid growth is occurring among the three-quarters of the world's peoples living in less developed countries where the post-World War II gap between high birth rates and falling death rates has only recently begun to narrow. This growth, coupled with high consumption in developed countries, is putting tremendous pressures on Earth's resources, environment, and social fabric. New evidence on Europe's demographic transition and from China, Indonesia, and Thailand in the 1970s suggests that well-designed family planning programs can speed fertility decline but rapid worldwide attainment of replacement-level fertility—an average family of about two children—will also require special development efforts and "beyond family planning" measures. Current projections for the world's ultimate peak population range from 8 billion in the mid-21st century to 11 billion about 2125, depending on when replacement-level fertility is reached. China's drive for a drastic birth rate reduction and the oil crisis might change fertility behavior more rapidly than most demographers have heretofore thought likely.

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Our Population Predicament: A New Look

By Jean van der Tak, Carl Haub, and Elaine Murphy

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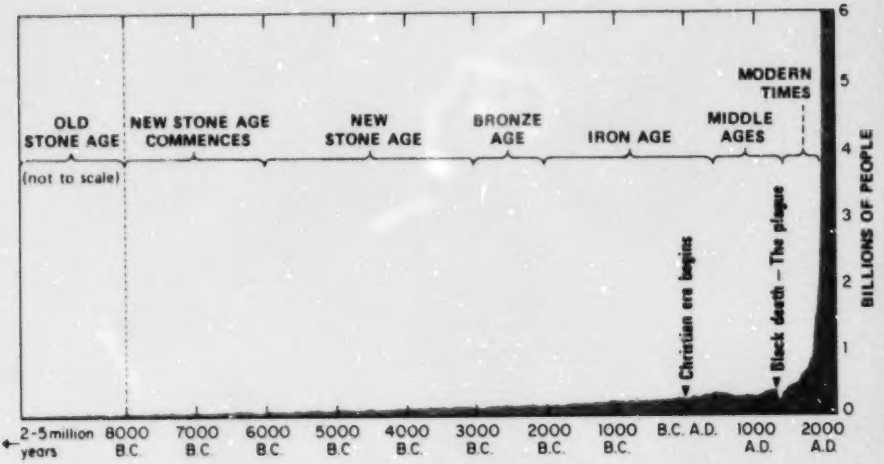
Figure 1. World Population Growth Through History



Population and Poverty

People

Major Resources Appear to Be Declining

Dim Outlook Seen For Poor Nations

Peru's Babies Are Dying

More Crowding Forecast In World's Poorer Cities

Human numbers took two to five million years to reach their first billion, about 1800 A.D. By 1975, 175 years later, the figure was up to four billion. Adding the next two billion could take only 25 years, according to current projections. Today's population explosion is putting tremendous pressures on Earth's resources, environment, and social fabric.

Our Population Predicament: A New Look

By **Jean van der Tak, Carl Haub,** and **Elaine Murphy**

Population Reference Bureau, Inc.

About this Bulletin

Published in April 1971, "Man's Population Predicament," by the Population Reference Bureau's then President and Editor, Rufus E. Miles, Jr., was one of the most widely quoted and distributed of the Bureau's 40-year series of Population Bulletins. *In graphic words and charts, Mr. Miles described the origins and implications of the post-World War II global population explosion. Among the first to see that explosion looming was Guy Irving Burch when he founded the PRB in 1929. Hailed as a "demographic Paul Revere," warning that people are coming!, Burch appears to have coined the very term "population explosion" in his November 1950* Population Bulletin, *"A Winning Program for Democracy," later condensed in* Reader's Digest. *Burch was cited with the Lasker Award after his untimely death in January 1951: "Perhaps more than any other individual he was responsible for today's awareness of the population problem and the need for positive action to resolve it."*

This "new look" at our population predicament is issued as a tribute to Guy Irving Burch; to PRB's 50 years of "telling the world about population"; and in recognition that awareness of the population problem, though growing, is needed more than ever as the 1980s dawn, along with much more positive and immediate action to resolve it.

To conclude this update, Rufus Miles has provided a thoughtful look at what he sees as the intensified "Age of Discontinuity" which the world is now entering as China aims for a drastic reduction in its birth rate and the era of cheap petroleum comes to an end.

Jean van der Tak is PRB's Director of Publications, Carl Haub is Staff Demographer, and Elaine Murphy is Director of Population Education. Jean van der Tak and Carl Haub are graduates of the Master's Degree Program in Demography of the Center for Population Research, Georgetown University. Dr. Murphy holds the Ph.D. in Human Development from the University of Maryland.

The authors are grateful for the helpful comments and suggestions received in the preparation of this Bulletin *from Leon Bouvier, Marshall Green, Rufus Miles, Conrad Taeuber, and their colleagues on the PRB staff. Parts of the* Bulletin *draw upon the excellent review of the current world population situation by Ambassador Marshall Green, former U.S. Department of State Coordinator of Population Affairs, and Robert Fearey, "World Population: The Silent Explosion,"* Department of State Bulletin *(Department of State Publication 8956, October 1978).*

The human population of the earth probably passed the 4.3 billion point in 1979, increasing by some 74 million each year. We say "probably" because population data are still scanty and unreliable for parts of Asia and Africa although demographers are becoming adept at making plausible estimates from deficient data. At its current 1.7 percent rate of increase, every three years the world population grows by nearly as many people as the 220 million living in the U.S. in 1979. Every five days we add another million people to our human population.[1]

This population explosion seems all the more awesome when seen in the perspective of humanity's development as a species. During the hundreds of thousands of years of the Old Stone Age when *homo sapiens* was a hunter and food gatherer, the world population

Table 1. Estimated Timing of Each Billion of World Population

	Time taken to reach	Year attained
First billion	2-5 million years	About 1800 A.D.
Second billion	Approx. 130 years	1930
Third billion	30 years	1960
Fourth billion	15 years	1975
Projections:		
Fifth billion	12 years	1987
Sixth billion	11 years	1998

Sources: United Nations, *The Population Debate: Dimensions and Perspectives. Papers of the World Population Conference, Bucharest, 1974*, Vol. 1, Population Studies No. 57 (1975) Table 1, *Demographic Yearbook 1962* and *1969*, and *World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment*, ST/ESA/SER.R/33(1979); and John D. Durand, "Historical Estimates of World Population," *Population and Development Review*, Vol. 3, No. 3 (September 1977) pp. 253-296

probably never exceeded 10 million. Somewhere about 8,000-6,000 B.C., humans learned how to grow food and create settlements and eventually cities. The shift from food gathering to food growing was a momentous change: far larger numbers could be supported. By the time of Christ, 1 A.D., world population had grown to about 300 million and by 1650 A.D. reached an estimated 500 million.

The increase from about 10 million at the beginning of the agricultural era to 500 million some 8,000-10,000 years later—a fifty-fold increase—was a "population explosion" in itself. This term, however, applies with greater accuracy to the far more rapid gain that has occurred in the past three and a quarter centuries and particularly in the 35 years since World War II (see Figure 1). The world reached its first billion around 1800—some two to five million years after the appearance of the first humanlike creatures.[2] Adding the second billion took about 130 years to 1930. The third billion was reached after only 30 years, in 1960, and the fourth after 15 years, in 1975 (Table 1). About 1965, the world's rate of population growth climbed to 2 percent—a rate at which numbers double in 35 years. That growth rate has now fallen slightly and is expected to continue to decline, although at an unknown pace. Even so, world population is projected to be about 6 billion by the year 2000, when the numbers being added each year could be well over 90 million. (The box on the opposite page explains some of the arithmetic involved in this growth.) The level at which mankind's total numbers will ultimately peak now appears to lie between 8 and 11 billion, depending on the determination with which the world addresses the problem.

Global population growth occurs as a result of the excess of births over deaths. Most of today's growth is taking place among the some three-quarters of the world's population living in the less developed regions—Latin America, Africa, and Asia (minus Japan). Here, previously high death rates fell rapidly after World War II and by about 1977 were at the comparatively low level of 12 deaths per 1,000 population per year. Birth rates, though beginning to fall—rapidly, in some cases—are still at an average 33 per 1,000 population annually. As a result, the developing regions are growing at a rapid 2.1 percent each year. By contrast, among the other quarter of the globe's population in de-

Demographic Arithmetic

Growth rates

Most growth rates referred to in this *Bulletin* are the *rate of natural increase*—annual births minus deaths per 1,000 population, expressed as a percentage. For example:

About 1977, the world had a birth rate of 28 per 1,000 population, a death rate of 11 per 1,000, and therefore, by subtracting 11 from 28 a natural increase rate of 17 per 1,000, or 1.7 percent.

For a country or region, as opposed to the world, a true *population growth rate* adds in the effect of net immigration or emigration. For example:

In 1978, the U.S. had a natural increase rate of 0.6 percent and a population growth rate of 0.8 percent, taking into account net legal immigration. (Illegal immigration adds more to the U.S. population growth rate, but the exact amount is unknown.)

Doubling time

One way to grasp the implications of a particular rate of population growth is to consider how long it would take a population growing at that rate to double. A 1 percent growth rate means a doubling in 69 years; a 2 percent rate results in a doubling in 35 years; and a 3 percent rate doubles a population in 23 years. A quick way to calculate a doubling time is to divide 69 by the percentage of growth. For example:

If the world's 1.7 percent population growth rate of 1979 were to remain constant, the current population of 4.3 billion would double to 8.6 billion in 41 years (69 ÷ 1.7 = 40.6).

Annual growth rate (%):	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Years to double population:	69	46	35	28	23	20	17

Growth rate versus numbers added

Even though a population's growth *rate* may decline, the *actual numbers of people added* each year may increase, because the base population is becoming larger and larger. For example:

In 1979, the world's population growth rate of about 1.7 percent applies to a global population of 4.3 billion for a gain of 73.5 million people each year (.017 x 4.321 billion = 73.5 million). About 2000, the United Nations projects that the world's population growth rate will be down slightly to 1.5 percent but the total population will be about 6.2 billion so that the numbers added each year will be up to 93 million (.015 x 6.199 billion = 93.0 million). See figure below.

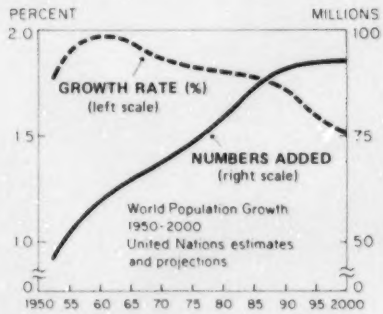
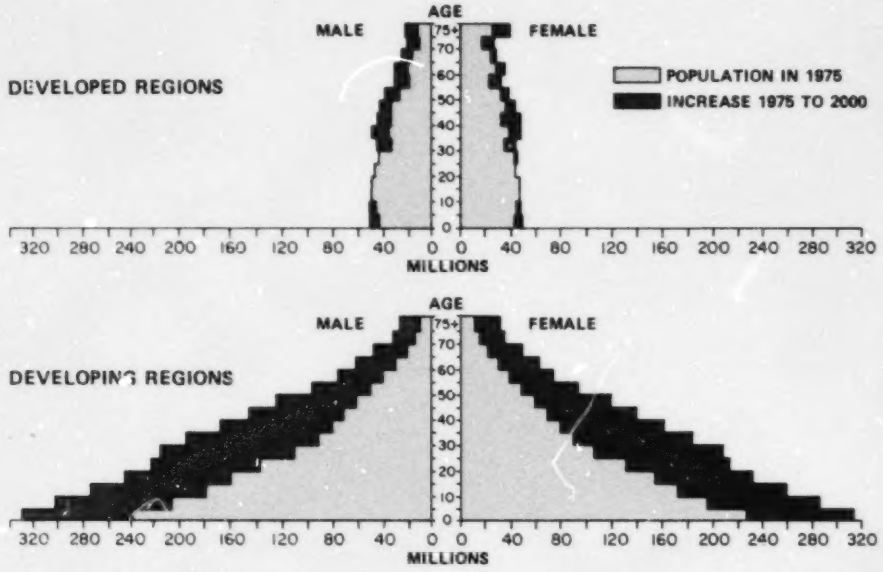


Figure 2. Population Age Pyramids: Developed and Developing Regions, 1975 and 2000



Source: Marshall Green and Robert A. Fearey, "World Population: The Silent Explosion," *Department of State Bulletin*, Department of State Publication 8956 (October 1978), based on U.S. Bureau of the Census, "Illustrative Projections of World Population to the 21st Century," *Current Population Reports*, Special Studies Series P-23, No. 79, January 1979. The data for 2000 represent the Census Bureau's medium projection.

veloped regions (the U.S. and Canada, Europe, the U.S.S.R., Japan, Australia, and New Zealand), the annual rate of growth now stands at a much lower 0.7 percent—reflecting an average birth rate of 16 per 1,000 and a death rate of 9 (1977 estimates). Figure 2 brings out strikingly the differences in current population size between the developed and the developing regions and the impact of their differential growth rates. Between 1975 and 2000, the population of developed regions is expected to grow slowly while that of the developing regions expands enormously. Much of the developing regions' growth will be due to their much larger proportions of young people now in or about to enter their childbearing years—the result of continuing high fertility and greatly improved survival of infants and children.

The explosive buildup of world population is putting tremendous pressures on Earth's resources, environment, and social fabric. The pressures are currently felt most acutely in developing regions where hundreds of millions already live in abject poverty and hunger. But the pressures are compounded by the developed countries' high per capita consumption of resources and output of pollution. The population predicament is shared by all humanity.

This *Bulletin* sketches the development of the predicament in modern times, Europe's "demographic transition" from high to low birth and death rates, the implications of that great shift for today's high-fertility, developing nations, and the beginnings of their transi-

tion. Sections follow on the consequences of rapid population growth and the worldwide response to the problem so far. The conclusion discusses prospects for the future and the approaches now being proposed to hasten attainment of global zero population growth before human numbers overshoot Earth's sustaining capacity.

The Explosion Takes Off

What has fueled the takeoff of world population growth in modern times? Population growth in global terms can come about in only one way—when births exceed deaths. This simple relationship is expressed in the "balancing equation" all students of population learn:

Population (at a later date) = Population (at the earlier date) + (births - deaths)

It is evident from Figure 1 (page 2) that, beginning about 1650, the excess of births over deaths worldwide must have become larger and larger.

The relationship in the equation, although quite basic, represents a more complex series of causes. Fluctuations in fertility, the number of births a woman *actually has*, obviously affect growth; fecundity, the number of births a woman is *able* to have, varies among populations; and mortality, the rate at which people leave a population through death, has different causes at different times in different areas. Improved fecundity brought about by better nutrition and disease control has played something of a role in modern population growth—in Western Europe during the 18th and early 19th centuries, for example, and in Sub-Saharan Africa today. Increased fertility played a role in the galloping growth of the U.S. and Canada during the 19th century: with the availability of seemingly boundless land, the millions of migrants who crossed the Atlantic were encouraged to produce larger families than their parents and grandparents often dared in land-short Europe.[3] But it is falling mortality that has been chiefly responsible for the sudden spurt in world population growth since about 1800.

Lower mortality means not only more population growth because people are being subtracted more slowly by death but also more births because more young people survive to and through their years of fertility. The devastating effect of high mortality on potentially fertile young people in past times is illustrated by the following:

"Abraham Lincoln's mother died when she was thirty-five and he was nine. Prior to her death she had three children: Abraham's brother died in infancy and his sister died in her early twenties. Abraham's first love, Anne Rutledge, died at age nineteen. Of the four sons born to Abraham and Mary Todd Lincoln, only one survived to maturity. Clearly, a life with so many bereavements was very different from most of our lives today."[4]

The mortality revolution

Humanity's first real control over pestilence (infectious disease) and famine—the scourges which, along with war, had kept death rates close to high birth rates throughout human history—took hold in Western Europe as the Industrial Revolution gathered steam in the late 18th century and early 19th century and spread to North America by the mid-19th century. This mortality revolution was triggered by social and economic changes that accompanied new agricultural technologies and increasing industrialization and urbanization. Improved agricultural techniques boosted food supplies which lessened the danger of famine and improved nutrition. With better nutrition came increased resistance to infection and tolerance of severe illnesses. Living conditions gradually improved as industrialization raised personal incomes. This brought better

housing, which reduced diseases associated with crowding, such as tuberculosis, and improved personal hygiene. Soap use went up and people switched from lice-hiding wool to cotton underwear.

Later in the 19th century and on into the early 20th century, public health and medical advances hastened the mortality decline. The need to separate water supplies from sewage was established; pasteurization of milk and smallpox inoculation were introduced; and medicine gradually reached the point where more people were cured by treatment than were killed by pre-antiseptic conditions. The causative factors of a host of ancient killers, including plague, yellow fever, cholera, typhus, dysentery, diphtheria, tuberculosis, and malaria were identified, and the means of controlling them developed.[5]

Death rates began to drop. In the 1840s in several Western European countries, data indicate that only about 85 percent of those born survived the first year of life and about 65 percent lived to age 15. A century later, close to 96 percent survived the first year and about 75 percent lived to age 60. The death rate in the now developed countries dropped from an estimated 28 per 1,000 population in 1850 to 15 in 1950 and 9 in 1977 (Figure 3).

Much of this decline in mortality reflected the greater survival of infants. In Sweden, for example, at the beginning of the 19th century, about 200 of every 1,000 children born failed to survive their first year. This infant mortality rate dropped gradually to 100 deaths per 1,000 live births about 1900 and then more rapidly to 21 by 1950 and about 8 by 1977. Although Sweden's infant mortality rate is now the lowest in the world, other Western countries have had a similar decline.[6]

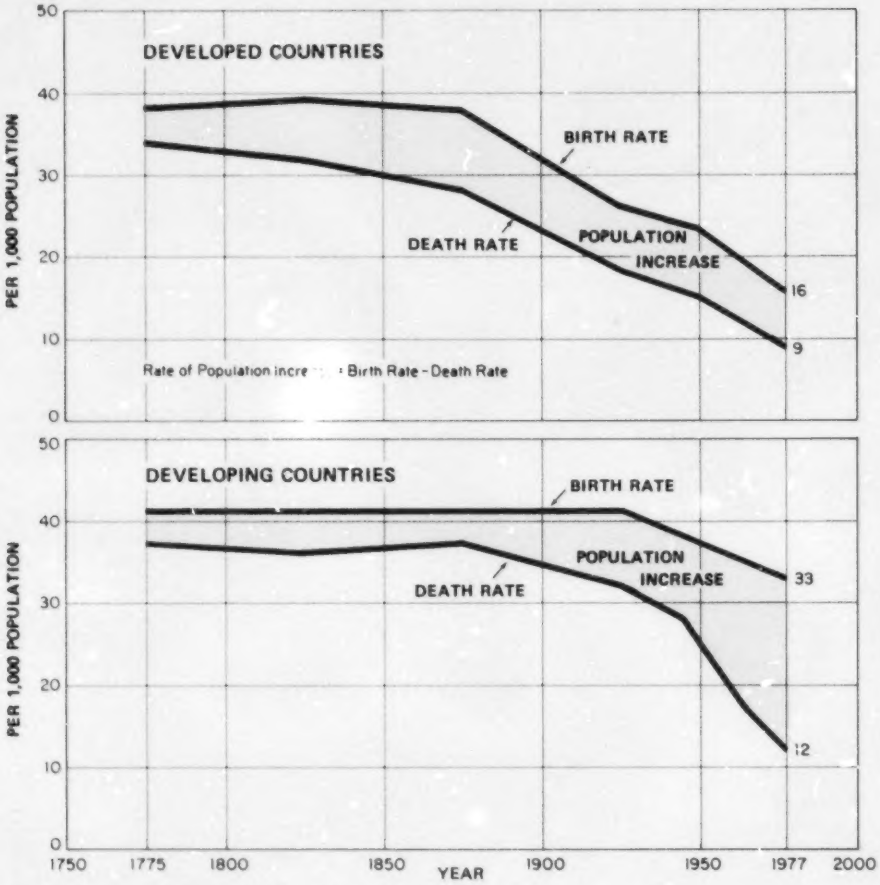
There were setbacks to the now developed world's mortality revolution. In Europe, the Irish potato famine of 1846 took 800,000 lives and the two world wars of the 20th century claimed millions more. But with the near elimination of most serious infectious diseases, the main causes of mortality shifted to the chronic and stress diseases, such as cancer and heart disease, which strike more among older people.

Late in the 19th century, birth rates also started to come down in the more developed countries in tandem with the gradually falling death rates, easing population growth before it could mount to a burdensome level. For Europe, population pressures were also eased by massive migration to the relatively empty lands of the New World—chiefly the U.S. and Canada, Argentina and Brazil, South Africa, and Australia and New Zealand. Between 1820 and 1930, an estimated 55 million Europeans—a quarter of Europe's population—left to seek their fortunes overseas.[7]

The story was different in the less developed world. Until the end of World War II, there was a gradual decline in mortality, probably due to improving water supplies and other public sanitary measures. But estimates indicate that death rates were still close to 30 per 1,000 in the late 1940s.

Following World War II, however, the decline in mortality became much steeper. In Sri Lanka (then Ceylon), for instance, the death rate came down from 20 to 14 in a single year and, in consequence, the estimated life expectancy at birth went up from 43 years in 1946 to 52 years in 1947. In general, in less developed countries, the death rate dropped from an estimated 28 per 1,000 population in the 1940-50 decade to 17 per 1,000 in the 1960-70 decade. The pace of decline has since slowed but, even so, the estimated rate for less developed countries as a whole was down to 12 per 1,000 by 1977 (Figure 3). There are wide regional variations, however. Latin America's death rate of just 8 per 1,000 population is lower than that of most developed countries (including the U.S. at 9 per 1,000), due largely to much higher proportions of young people. Asia's death rate is 11,

Figure 3. Birth and Death Rates: Developed and Developing Countries, 1775 to 1977



Source: Population Reference Bureau, based on United Nations estimates.

while Africa's death rate of 17 is the highest of any region.[8]

The developing world's mortality revolution was triggered not by social and economic development as in the West, but by medical and public health technology—antibiotics, sanitation, immunization, insecticides (DDT to strike at malaria-bearing mosquitoes, for example), and campaigns against such major killers as smallpox. Much of this technology was imported and applied overnight through international health and foreign aid programs, and food aid cut

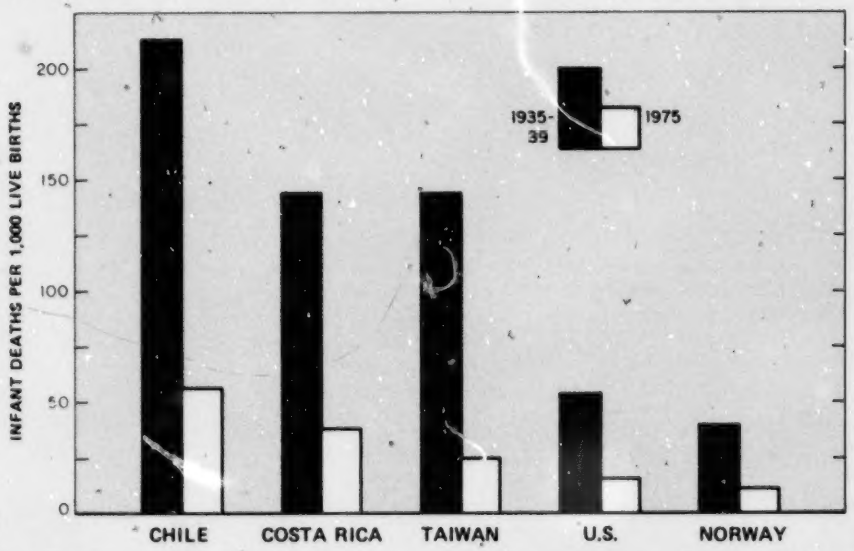
famine tolls in times of drought. The result was a telescoping into two decades of the mortality decline that had taken a century in the developed world. Birth rates have scarcely had time to adjust and population growth rates have soared.

The reduction in infant mortality has particular significance in terms of the population equation since the survival of children means they will probably become parents themselves. Although deaths among infants in many less developed countries, particularly in Africa, are still five to seven times what they are in industrialized nations, the decline since the 1930s has been dramatic in many cases. For example, as seen in Figure 4, between 1935-39 and 1975, annual infant deaths per 1,000 live births fell from 213 to 56 in Chile and 144 to 25 in Taiwan. In the U.S. in the same period, the decline was from 53 to 16.

Europe's Demographic Transition

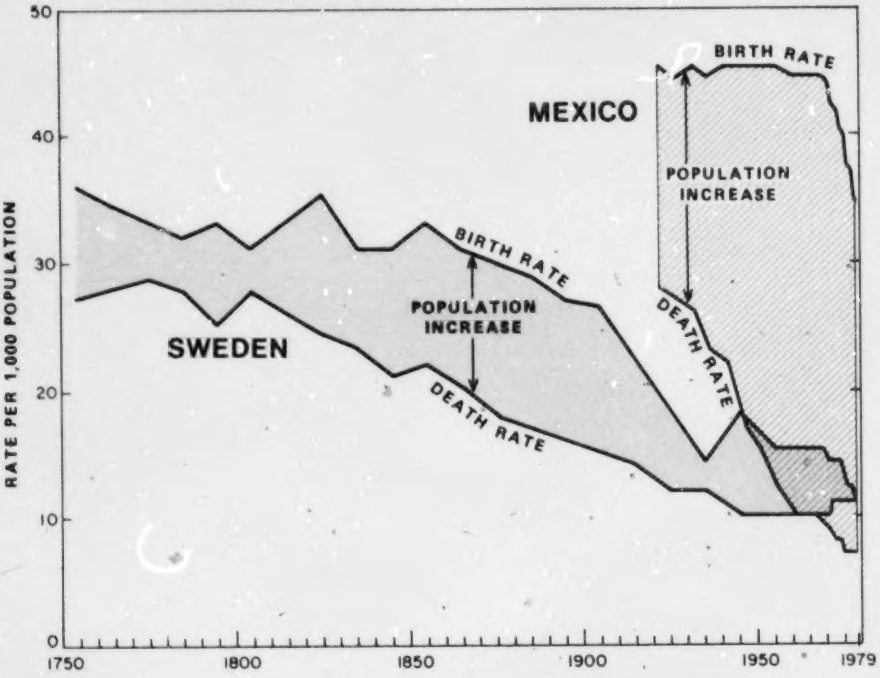
The historical pattern of Sweden's birth and death rates shown in Figure 5 is typical of Western European countries. Until the late 18th century, both rates fluctuated at a relatively high level. Then as the Industrial Revolution accelerated in the early 19th century, the death rate began to fall gradually, followed some 50 to 70 years later by the birth rate. By the 1930s, both were at low levels. Today, following a brief post-World War II rise in the birth rate, Sweden's annual births and deaths are in balance and the population has stopped growing from natural increase. This pattern applies generally to the now developed

Figure 4. Infant Mortality Decline: Selected Countries, 1935-39 to 1975



Sources: Taiwan, 1975, U.S. Bureau of the Census, *Republic of China*, Country Demographic Profile, ISP-DP-12, 1978. All other data, United Nations, *Demographic Yearbook 1966* and *1977*

Figure 5. Birth and Death Rates: Sweden, 1755-1978, and Mexico, 1920-1979



Sources:
Sweden: 1775-1970: Gosta Guteland et al. *The Biography of a People: Past and Future Population Changes in Sweden* (Stockholm: Royal Ministry for Foreign Affairs, 1974). 1971-78: United Nations, *Demographic Yearbook 1977* and *Monthly Bulletin of Statistics*, September 1979.
Mexico: 1920-72: John S. Nagel, "Mexico's Population Policy Turnaround," *Population Bulletin*, Vol. 33, No. 5 (December 1978), Figure 2; 1973-79: U.S. Bureau of the Census, *Mexico*, Country Demographic Profile, ISP-DP-14, 1979.

countries, although there are exceptions. In the U.S. and Canada, for example, birth rates were higher in the late 18th century and throughout most of the 19th century than they were in Europe, and the post-World War II rise in birth rates was prolonged to the early 1960s. However, now, in the late 1970s, as in most developed countries, the gap between their birth and death rates is narrow: in 1978, in the U.S., the birth rate was 15 per 1,000 population and the death rate was 9, and in Canada, the rates were 15 and 7.

Since the 1930s, demographers have sought to explain how and why this evolution from high to low birth and death rates came about in today's developed countries. The best known explanation, based mainly on what was thought to be the experience in Western Europe, is known as the demographic transition theory. In its "classic" form, this theory describes three stages:

- The *initial stage of potentially high population growth* evolves from a backdrop of high death rates reflecting harsh living conditions and high birth rates needed to compensate for high infant mortality. With improved living condi-

tions and control over disease brought about by "modernization," death rates begin to fall. At first, birth rates remain high, causing a rise in population growth.

- During the subsequent *transitional stage*, the rate of population growth is still relatively high, but a decline in birth rates becomes well established. The small-family ideal arises first among "upwardly mobile" couples, particularly in cities, who come to see too many children as a hindrance to taking advantage of the opportunities offered by the expanding industrial economy. The preference for few children gradually diffuses throughout the country, aided by declining rates of infant mortality.
- The *stage of very low or zero population growth* is reached when mortality is low and fertility hovers around replacement level. Fertility could stabilize below replacement level, leading, in the absence of net immigration, to an eventual decline in the absolute size of a country's population. (Replacement level fertility is explained in the next section.)

Relevance for less developed countries

This view of Europe's historical record and the "theory" based on it have shaped much of the recent thinking about the gap between birth and death rates in today's less developed countries (LDCs), such as Mexico (Figure 5). Particularly emphasized are the notions of fertility decline as a more or less automatic reaction to mortality decline and socioeconomic development as the stimulant for both declines. These ideas have been used to argue that organized family planning programs cannct do much to precipitate or accelerate fertility decline in the developing world. Birth rates will begin a general decline, it is held, only when socioeconomic development has reached such a "threshold" of literacy, infant survival, industrialization, and urbanization that the majority of individual couples perceive small families to be to their own advantage. Modern contraceptives are not necessary for this fertility decline to take place, it is alleged, since much of Europe's fertility decline occurred long before the advent of pills, intrauterine devices (IUDs), and sterilization. This argument was summed up in the rallying cry of many Third World government delegations to the 1974 World Population Conference in Bucharest: "Development is the best contraceptive."

Over the long run, the decline in European birth rates did indeed take place against a general background of modernization and falling mortality. However, a recent spate of studies based on new analytical methods and much more detailed evidence now reveals that there were many deviations from the pattern described in the classical demographic transition theory. Thus it is possible that the shift to low fertility in today's LDCs might also occur differently.*

These studies confirm that in England, for example, birth rates did start falling only after considerable urbanization and industrialization had occurred, late in the 19th century. But they also reveal that the decline began about the same time in far less developed Hungary. And the first evidence of fertility decline was in France, a century earlier, when that country's people were overwhelmingly rural, poor, and illiterate, and infant mortality was still very high. This suggests that a well-designed family planning program could reduce birth rates in a preindustrial society before the speculated "threshold" of development is achieved. Even if some socioeconomic development may be necessary to touch off a fertility decline, there is no telling precisely what factors—or com-

*This new analysis of historical evidence and its implications for population policies in today's LDCs have been summarized by demographers John Knodel and Etienne van de Walle in a recent *Population and Development Review* article[9] and for PRB's next *Population Bulletin*.

bination of factors—make up such a threshold and, conversely, no assurance that development alone will trigger a fertility decline.

The evidence of widespread infant and child abuse turned up by this recent research suggests that large families were not necessarily desired in pretransition Europe—a reason often given for the persistence of high fertility in some LDCs today. Neglect, abuse, and resulting high rates of infant and child mortality may have been one way of adjusting to high fertility rather than vice versa. Similarly in some LDCs today, high infant mortality may in part reflect couples' reactions to unwanted births (and recent research in Latin America points in this direction[10]). It could be that alternative methods of birth control are simply unknown, inaccessible, or considered objectionable.

This was apparently true in pretransition Europe. Of the two available methods other than abortion, it now appears that withdrawal was less well known than has been assumed and associated mainly with extramarital sex. And long-term abstinence required a high degree of self control. Both were also male methods while it was the women who bore the brunt of incessant childbearing and probably wanted fewer children. Wives in developing countries may also be more interested in birth prevention than their husbands, the historical researchers suggest, and thus current family planning programs which "stress female methods, such as the pill, IUD, injections, and tubal ligation, should contribute to an acceleration of fertility decline."[11] In other words, it may not be necessary to wait for infant mortality to fall in a given LDC before women can be expected to accept modern contraception.

That family limitation took hold in Europe and areas of Western culture overseas like English-speaking Canada mainly in just 30 years from 1880 to 1910, despite widely different circumstances, suggests another lesson from the past. Once some couples lead the way, the idea and practice of family planning can diffuse rapidly. Family planning programs which provide both effective means of fertility control and information about them can speed up this innovation-diffusion process. The historical reproductive revolution also seemed to follow cultural and linguistic lines, independently of socioeconomic development. In Europe, ethnic pockets of high fertility, as in Flemish-speaking Belgium, remained long after considerable development had taken place and after fertility had fallen elsewhere. This is true today in the Muslim Central Asian republics of the U.S.S.R. and other societies where women are extremely subordinated and isolated. In such societies, it is suggested, "policies designed to alter the status of women may be more conducive to reduced fertility than either family planning alone or more general development efforts."[12]

In sum, the history of Europe's fertility decline as reexamined does appear relevant for today's developing nations, al-

Peace Corps photo

The large numbers of children in less developed countries hold the potential for vast world population increases in the future (page 14).

though the "classical theory" of demographic transition may now have to be revised. The new studies do not deny that socioeconomic development enhances couples' motivation for smaller families. But they also suggest that "in many cases a greater payoff [in hastening birth rate decline] might well result from concentrating efforts on improving and extending existing family planning programs."[13]

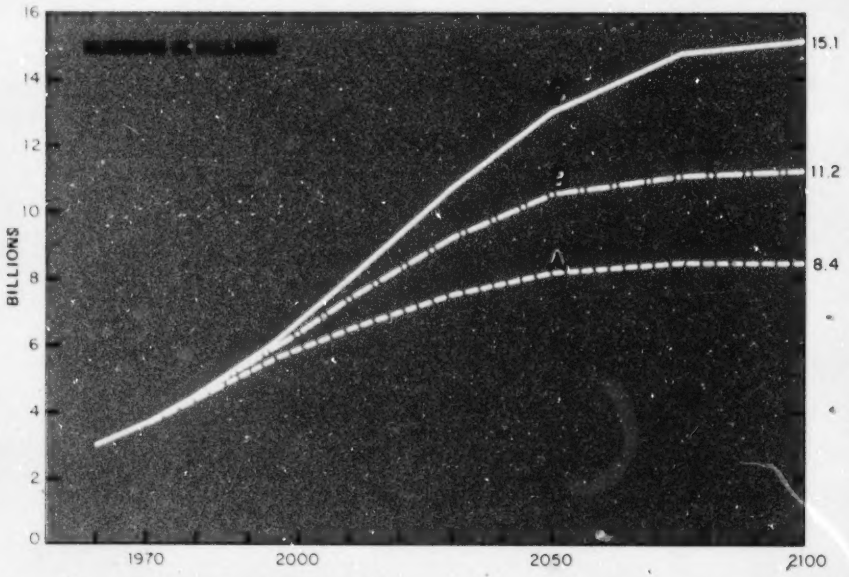
Birth rate reductions in present-day developing countries have often been closely associated with economic and social progress before organized family planning got underway (Singapore, Taiwan, Costa Rica, Hong Kong, and South Korea, for example). However, significant declines have also occurred in relatively backward socioeconomic settings but where political, bureaucratic, and community resources—and womanpower—have been fully mobilized behind family planning (China and Indonesia). On the other hand, Mexico's birth rate remained well above 40 per 1,000 until the mid-1970s, despite rapid economic growth and urbanization and a heavy emphasis on education. A national population program was launched in 1973 and the birth rate has since declined markedly (Figure 5).

In two important respects, the demographic transition in today's developing world is and will be very different from that of Europe. In developing countries, birth rates were often in the high 40s per 1,000 population about 1950-55 at the beginning of their demographic transition and still are that high in Africa today, due in part to early and universal marriage. By contrast, the average in Western Europe in the late 18th century was 30-35 per 1,000. Also, the mortality decline which took a century or more in Western Europe occurred precipitously in most LDCs in about 15 years from the late 1940s to the early 1960s. The result has been population growth rates two or three times what they ever were in Western Europe. Mexico's rate of natural increase reached an explosive 3.5 percent in 1964-66, for example, whereas Sweden's never exceeded 1.2 percent.[14]

The Momentum Factor

The runaway population growth of developing countries in the past three decades is not only adding huge numbers now but also holds the potential for vast population increases in the future and a long delay before annual births come down to annual deaths and the world reaches zero population growth. With high fertility coupled with dramatic declines in mortality, some 40 to 50 percent of developing countries' populations are now composed of children under age 15 in contrast to only 25 percent in developed regions. (Compare the broad-based 1975 population age pyramid of the developing regions in Figure 2, page 6, with the narrow base of that of the developed regions.) Because of this, population would continue to grow for a long time even if it were possible to attain, in the next few decades, an average level of fertility worldwide that would merely replace the parent generation—2.1 to 2.5 children per woman, depending on mortality conditions. The numbers of young people coming into the ages of fertility in developing countries are so much larger than the numbers of people at older ages that, even if couples were to average only enough children to replace themselves, total births would continue to outstrip total deaths until the disproportion in the number of people in the childbearing ages disappears. This could take a century or more in countries where population growth has been very high. The size of the eventual zero growth population would be far larger than at the time fertility dropped to replacement level.

Figure 6. Momentum of World Population Growth



IF THE WORLD ATTAINED REPLACEMENT FERTILITY IN[a]	WORLD POPULATION WOULD THEN STAND AT	AND WORLD POPULATION COULD BE EXPECTED EVENTUALLY TO STABILIZE AT
(A) 2000–05	5.9 BILLION (2000)	8.4 BILLION
(B) 2020–25	8.4 BILLION (2020)	11.2 BILLION
(C) 2040–45	12.0 BILLION (2040)	15.1 BILLION

Source: Tomas Frejka, *The Future of Population Growth: Alternative Paths to Equilibrium*, A Population Council Book (New York: Wiley Interscience, 1973).

[a]The fertility decline is assumed to begin in all cases with the 1965-70 level. Thus, replacement-level fertility (2.1-2.5 births per woman) by 2000-05, for example, implies a gradual reduction of fertility over a 35 year period.

Figure 6 illustrates the implications for the world of this almost irresistible momentum of growth built into the current youthful age structure of the three-quarters of the world's population living in developing countries. If fertility worldwide were to decline to replacement level by 2000 and stay there—a very optimistic assumption—global population would stop growing only some 60 years later at 8.4 billion, nearly double its 1979 size. If replacement-level fertility is delayed to 2040-45, the ultimate steady-state population would be 15.1 billion, three and a half times that of 1979. (Population Council demographer Tomas Frejka used 1965-70 as the base period in calculating these projections. He expects new calculations, now in preparation, will somewhat reduce the ultimate population totals shown here.)

Table 2 (next page) shows what popu-

Table 2. Projected Timing of Replacement-Level Fertility and Ultimate Population Size: Selected Developing Countries

(Population in millions)

Country	Mid-1977 population	Assumed year when replacement level fertility is reached	Hypothetical size of ultimate stationary population	Year when stationary population is reached
India	632	2020	1,643	2150
Brazil	116	2015	341	2075
Indonesia	134	2020	357	2145
Bangladesh	81	2035	334	2165
Nigeria	79	2040	435	2135
Mexico	63	2015	204	2075
Thailand	44	2005	105	2095
Egypt	38	2010	90	2105

Source: World Bank, *World Development Report 1979* (New York: Oxford University Press, 1979), Table 17.

lation momentum means for eight large developing countries, as recently calculated by the World Bank. Mexico, for example, could reach replacement-level fertility by 2015 if its recent family planning program progress continues, according to the World Bank—down from about 6 children per woman in 1975. If this level held, Mexico's population would take another 60 years to stop growing and would then be more than three times its 1977 size. India, currently the world's second most populous country after China, would take more than a century to reach a stabilized population of 1.6 billion after achieving replacement-level fertility about 2020, according to these calculations. For the world as a whole, the World Bank currently projects replacement-level fertility also about 2020 and an ultimate stationary (non-growing) population of about 9.8 billion, achieved about 70 years later.

Several developed countries now have below-replacement-level fertility, that is, fewer than two births per woman among those now bearing children. If this were to become widespread, growth would stop sooner and the world's population would stabilize at a smaller size. A sustained fertility level below replacement would eventually lead to a decline in the absolute size of a population. China is about to become the first country to adopt such a policy. A new law is being formulated to promote the one-child family with the eventual aim of achieving negative population growth and a reduction in total population size. If successful, this could greatly accelerate the cessation of global population growth at a smaller number than most demographers have hitherto thought possible since China accounts for over a fifth of the world's population.

LDC Birth and Death Rates in Transition

Although reliable data to verify trends are lacking for many less developed countries, most demographers are now convinced that fertility has begun to decline in developing countries as a whole, and in some LDCs the decline is much more rapid than it was in Europe. At the

same time, the precipitous decline in LDC death rates that marked the 1950s and early 1960s appears to have slowed.

Parker Mauldin and the late Bernard Berelson, former Population Council researchers, estimated that in the decade from 1965 to 1975 the birth rate of 94 LDCs with 98 percent of the developing world's population declined on average about 13 percent, from about 41 to 35.5 births per 1,000 population.[15] In 28 developing countries containing over two-thirds of the world's population, the decline ranged from 10 to 40 percent. The decline was most marked in Asia and Latin America. Sub-Saharan Africa showed virtually no fertility decline and, with death rates continuing to fall, population growth in Africa had climbed to 2.9 percent about 1977, the highest of any region.

Demographers Amy Ong Tsui and Donald Bogue of the University of Chicago analyzed the record for 1968-75 in a recent *Population Bulletin* and came to essentially the same conclusion as Mauldin and Berelson: the fertility transition has now begun for much of the developing world, most rapidly in such populous Asian countries as China, Indonesia, South Korea, the Philippines, and Thailand.[16] They estimate that the world's total fertility rate or average rate of childbearing fell from 4.6 births per woman in 1968 to 4.1 births in 1975.

In Asia, increasingly delayed marriage appears to have accounted for much of this decline. However, in general, the major cause to date has been reduced fertility among married women, particularly those over age 30. This relates in varying degrees to a fairly steady growth in the proportion of women of childbearing age who use modern contraceptive methods, accelerated in many LDCs by organized family planning programs.

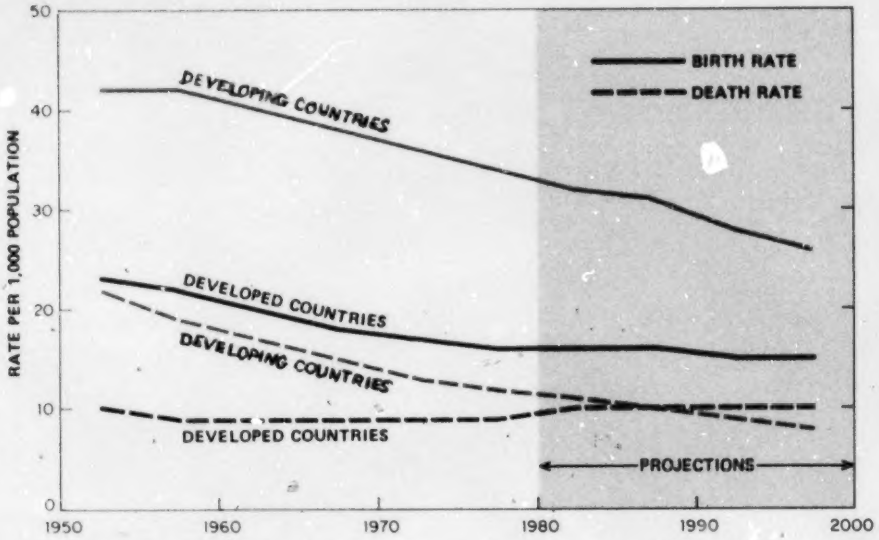
While LDCs have made progress in fertility decline, the spectacular post-World War II progress in reducing mortality has been slowed. In the mid-1950s, life expectancy at birth in LDCs as a whole was increasing annually by 0.7 years. By the early 1970s, the annual gain was down to 0.4 years.[17] The slowdown was most marked in Latin America and in such Asian countries as Sri Lanka, where life expectancy had risen by a spectacular two years annually in the early 1950s, but actually declined between 1967 and 1971. Infant mortality has also risen recently in Sri Lanka and in the swelling cities of Latin America.

It had been expected that life expectancy gains would slow in the developing world once imported medical technologies and health services gained control over such infectious diseases as malaria, smallpox, and tuberculosis. But the slowdown came earlier than anticipated. The United Nations predicted in 1962, for example, that by the early 1980s, life expectancy at birth would stand at 65 years for the "vast majority of the world's peoples."[18] But it is now still in the 40s and low 50s for much of the Third World.

The slowdown which economist Davidson Gwatkin calls "the end of an era" seems related to the rise of dysentery, diarrhea, and pneumonia as leading causes of death, particularly among infants and children. These diseases, often precipitated by malnutrition, are harder to control with modern medicine and physician- and clinic-based health services. Eradicating them takes improved living conditions, especially more and better food and education. For most developing countries, rapid population growth has frustrated this possibility.

The beginnings of fertility decline in many LDCs and the slowdown in mortality decline have combined to stop the steady rise in the world's rate of population growth. The peak was probably passed somewhere in the mid-1960s—a "demographic watershed of historic proportion."[19] The world's birth rate fell below 30 for the first time on record around 1975 and by 1977 was at an unprecedented 28 per 1,000 population.[20] According to the United Nations, the rate of population growth in LDCs as a whole

Figure 7. Birth and Death Rates: Developed and Developing Countries, 1950-1980, and Projections to 2000



Source: United Nations, *World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment*, ST/ESA/SER.R/33 (New York: 1979).

peaked at 2.4 percent in 1960-65, is now down slightly to 2.2 percent, and could narrow a bit more to 1.8 percent at the end of the century (see Figure 7). The total world growth rate is then projected to be 1.5 percent as compared to about 1.7 percent in the late 1970s.

Though encouraging, these trends still add up to huge numbers. As noted, the current 1.7 percent world growth rate is adding some 74 million a year to today's global total of about 4.3 billion. By 2000, 20 years hence, the United Nations projects a total world population of 6.2 billion, with the lowered growth rate of 1.5 percent translating into an annual net increase of about 93 million people. Some 90 percent of the 2 billion increase in the next two decades will take place in the developing world.

Current Population Trends in Developed Countries

The developed world's already low birth rates have sunk even lower in recent years and are now generally in the mid-teens, less than half the birth rates of the developing world (Figure 7). Death rates have also fallen to levels about as low as they can go without breakthroughs in conquering chronic diseases which strike mostly in old age—heart disease, cancer, and stroke. In some countries, death rates are rising as increasing proportions of the population are composed of the elderly among

whom death is more likely.

Fertility is at or below replacement level in some 14 developed countries, including the U.S. Indeed, fertility is now as low as, or lower than, mortality in Austria, Belgium, East and West Germany, Luxembourg, Sweden, and the United Kingdom.[21] Overall, however, population is still growing by 0.7 percent annually among the quarter of the world's peoples living in more developed countries, as seen in Figure 7. The U.S. now has below-replacement-level fertility of about 1.8 births per woman, but because of the momentum factor there were 1.4 million more births than deaths in 1978. The U.S. population is thus still growing by about 0.6 percent a year from natural increase. Net legal immigration of about 400,000 annually raises the U.S. population growth rate to 0.8 percent and illegal immigration adds more, although no one knows the exact amount.

Approaching population stabilization and even decreases in absolute numbers have aroused concerns in some developed countries. Eastern European countries, fearing labor shortages in the future, have stepped up pronatalist incentives—child bonuses, and paid leave and supplementary income for working mothers, for instance, and Czechoslovakia, Hungary, and Romania have somewhat tightened their very liberal abortion laws. These measures appear to have had some effect: except for East Germany, birth rates are now in the upper teens in Eastern Europe.

In the U.S., the prospect of a doubling in the elderly proportion of the population (age 65 and over) from 11 percent about 1980 to 22 percent about 2030 when the post-World War II baby boom generation reaches retirement age has aroused concerns about strains on the worker-supported social security system. There will then be only about 3 persons of working age (15-64) for every person of retirement age, in contrast to the current 6 persons aged 15-64 for every retiree.

Developed countries have had and will have a long time to prepare to meet these potential problems presented by current low fertility and resulting changes in population age structure. For developing countries, the very different and massive problems created by their explosive population growth are with them and the whole world now.

Consequences of Rapid Population Growth

The consequences of rapid population growth are evident across the spectrum of human, animal, and plant life. In the less developed world, despite the recent slight slowdown, population is still growing in some countries at rates that could double the numbers of people in just over 20 years. These countries are already hard pressed to supply their current populations with decent living conditions. In countries like the U.S. that have undergone the demographic transition, the problem seems to be of a different order of magnitude. A growth rate of under 1 percent, which would take a century or more to double a country's population, seems less threatening. Yet when put in the context of other global challenges, including continuation of economic progress, balancing world supplies of food, energy, and natural resources, and preservation of the global environment, the growth of the industrialized countries appears nearly as critical.

Economic development

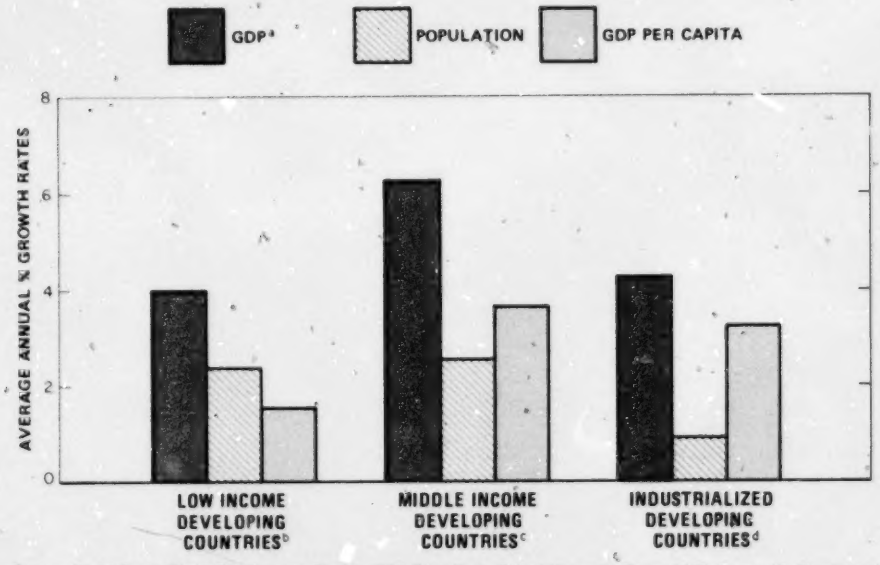
Besides exporting the medical and public health revolution to the rest of the world, the Western industrialized nations have also tried, since World War II, to speed economic development and hence raise levels of living in the developing world. Improving living conditions requires that

economic growth significantly outpace population growth. As Figure 8 demonstrates, from 1960 to 1976, overall economic growth in low-income developing countries nearly matched that of the industrialized countries, and economic growth in middle-income LDCs was spectacular. But because of much more rapid population growth, the developing world's gain in income *per capita*, and thus levels of living, was much less.

Rapid population growth diverts resources that might otherwise be available for investment in development. As Ambassador Marshall Green, former Coordinator of Population Affairs for the U.S. Department of State, succinctly puts it:

"When you have a country like Bangladesh, where the population growth every year is over 2 million people, you have to have 400,000 more tons of grain, 700,000 more jobs, 300,000 more dwellings, and 11,000 more schools. How are you ever going to aggregate the capital necessary for development when infrastructure costs are so enormously high?"[22]

Figure 8. Average Annual Growth in Gross Domestic Product, Population, and GDP Per Capita: Developed and Developing Countries, 1960-1976



Source: World Bank, *World Development Report, 1979* (New York: Oxford University Press, 1979) Figure 12. Reproduced with permission.

[a]Gross *domestic product* (GDP) is the value of goods and services produced in a country. Gross *national product* (GNP) adds in the net income received from abroad either from investments or citizens' earnings outside the country.

[b]Per capita GNP of U.S. $300 and below in 1977.

[c]Per capita GNP above $300 in 1977.

[d]Includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, West Germany, Iceland, Ireland, Italy, Japan, Luxembourg, The Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom, U.S.

Note: These data exclude countries which the World Bank classifies as *Capital Surplus Oil Exporters* (Kuwait, Libya, Oman, Qatar, Saudi Arabia, and United Arab Emirates) and *Centrally Planned Economies* (Albania, Bulgaria, China, Cuba, Czechoslovakia, East Germany, Hungary, North Korea, Mongolia, Poland, Romania, and the U.S.S.R.).

With up to 70 percent of the population in many LDCs dependent upon agriculture, an important key to economic development is improvement of the agricultural sector. But it is in the agricultural areas of these nations that fertility is usually highest. The result is either out-migration or more and more people on the land, further subdivisions of family holdings, lower output per worker, and a perpetuation of poverty. Similarly, in many developing countries, family size is usually highest among the poor. With many dependents for each working member, resources are spread too thin to allow for the "investments" beyond sheer survival, such as education, which might help these families lift themselves out of poverty.

The discouraging cycle of development handicapped by excessive population growth, and of rapid population growth continuing because the majority of families perceive little chance for economic progress, can be overcome only through a variety of carefully formulated, vigorously pursued measures adapted to each country's needs. But one of the principal requirements in most less developed countries is clearly the earliest possible reduction of high fertility rates.

Employment

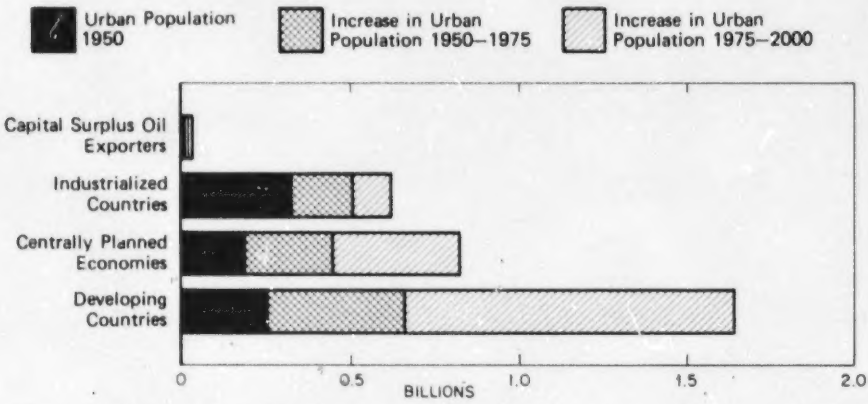
In the two remaining decades of this century, the disheartening effects of past and future population growth in developing countries may be most evident in their exploding labor forces and cities.

Unemployment has become a major problem in the developed world during the 1970s with recurring recessions associated with soaring energy prices coinciding with the coming of age of the post-World War II baby boom generation. But in developing countries the problem is far more daunting and is worsening. The International Labour Office (ILO) estimates that in 1975 there were around 283 million people unemployed or underemployed in the non-Communist developing world—40 percent of the workforce of some 700 million outside China and other Communist countries.[23] About 33 million of these were wholly unemployed; the rest underemployed, that is, seeking additional work either because they worked only a few hours in the day or days in the year or because their income was inadequate to meet their basic needs.

According to the ILO, the high and in some cases rising population growth rates of the late 1960s and early 1970s will translate into an increase in the developing world's labor force from 1.13 billion in 1975 to 1.91 billion in 2000.[24] With these 780 million new workers added to the 283 million currently unemployed or underemployed (outside China), this quarter century will see the need for more than a billion new jobs in the developing world where job-creating development is proceeding all too slowly. Particularly worrisome is the high projected labor force growth—and hence probably also unemployment—among urban youth aged 15 to 24, politically and socially the most volatile of all age groups.

Job shortages have already forced millions of would-be workers to migrate from developing countries. The World Bank estimates that industrialized countries of North and West Europe currently have over 6 million workers from Northern Africa and less developed countries of Southern Europe such as Yugoslavia and Portugal.[25] Leonel Castillo, former Commissioner of the U.S. Immigration and Naturalization Service, has placed the number of illegal migrants now in the U.S. at 3 to 6 million, the majority of them from Mexico.[26] Over the long run, lower fertility and economic progress in developing countries should reduce the supply of excess labor. Meanwhile, the "escape valve" causes social problems for migrant workers and the host countries and complicates international relations. This is nowhere so true as with "undocumented aliens" in the U.S. Some people are also concerned

Figure 9. World Urban Population Estimates and Projections: 1950-2000



Source: World Bank, *World Development Report, 1979* (New York: Oxford University Press, 1979) Figure 10. Reproduced with permission.
Note: For countries included in these four categories, see Figure 8.

that the increasing, if unknown, contribution of illegal immigration to net population growth in the U.S. dims the prospect of this country's reaching zero population growth. In Europe, recruitment of foreign labor has tightened with the economic slowdown since 1973 and several countries have subsidized the return of foreign workers to their native lands.

Urbanization

By the year 2000, over half the world's population is likely to be living in towns and cities, up from 39 percent in 1975. For developing countries, this worldwide phenomenon presents very different prospects from what it did in the past for the now developed world. As the World Bank puts it:

> "Whereas urbanization in the industrialized countries took many decades, permitting a gradual emergence of economic, social and political institutions to deal with the problems of transformation, the process in developing countries is occurring far more rapidly, against a background of higher population growth, lower incomes, and fewer opportunities for international migration."[27]

Enormous numbers of people are involved. Between 1950 and 1975, the urban population of developing countries grew by some 400 million people. Between 1975 and 2000, the increase will be close to one billion (Figure 9).

The problem is aggravated by the concentration of urban dwellers in very large cities. In 1950, only one city of the developing world (Greater Buenos Aires) had a population over 5 million, compared to five such cities in the industrialized countries. By the year 2000, according to World Bank projections, the developing world will have about 40 cities this size and the developed world 12. Eighteen cities in developing countries are expected to have more than 10 million inhabitants, and one at least—Mexico City—may well have three times that number.

Contrary to what is often believed, the flight of job searchers from rural areas is not always the main factor in the developing world's relentless urban growth. In Latin America, for example, where more than half the population already lived in urban areas in 1975, rural-urban

migration is expected to slow considerably in the coming decades and the growth in urban dwellers to three-quarters of the region's population in 2000 will be due mainly to natural increase (the excess of births over deaths) within cities. In the low-income countries of Asia, living and working conditions are generally no better in cities than in rural areas, a fact which discourages rural exodus. But this region already has some of the world's largest cities and urban populations: in 1975, for example, the urban population of India was greater than the combined urban populations of Argentina, Brazil, and Mexico.[28]

Whether due to rural-urban migration or natural population increase, it is clear that burgeoning population is putting tremendous pressure on the abilities of LDC cities to cope. In many of these cities, more than half the population lives in slums and squatter settlements; between one-fourth and one-third of the population has no access to safe water supply or facilities for human waste disposal; and people live five or six to a room, acutely aware of the great disparity between the poverty of the majority and the wealth of the urban elite. All this contributes to alienation and frustration on a massive scale.[29]

Public services

In rural and urban areas alike, the populations of many less developed countries are growing faster than educational, health, sanitation, transport, and other public services can be provided.

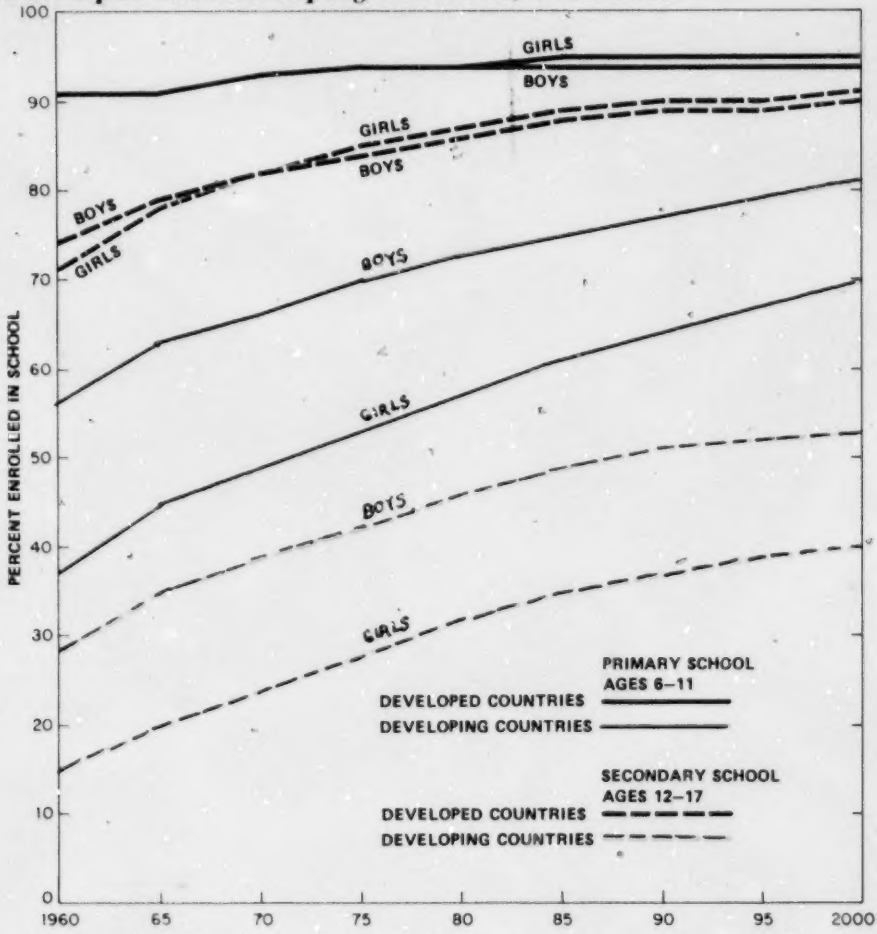
Most LDCs have made heroic efforts to improve educational opportunities, and the proportion of school-age children enrolled in school has indeed been rising. Nevertheless, the gaps in enrollment between developed and developing countries, and between boys and girls in developing countries, remain large and, according to UNESCO, will remain large to the end of the century (Figure 10, page 24). Moreover, despite growing enrollment rates, fast-growing populations of young people mean increases in the absolute numbers of children out of school. UNESCO estimates that there will be 130 million children aged 6-11 out of school in developing countries in 1985, up from 119 million in 1970.[30] Similarly, the *number* of illiterate adults worldwide increased from 700 to 800 million between 1950 and 1975 even though the *proportion* of such adults dropped from 44 to 32 percent during that quarter century.

Housing is a particularly critical problem. In Asia, the backlog of needed housing units in urban areas increased from 22 million dwellings in 1960 to 72 million in 1975; in Asia's rural areas, the need for housing units went from 125 to 219 million in the same 15 years.[31]

Health facilities are on a similar treadmill. Inability to keep up with the demand from growing populations is part of the explanation for the recent slowdown in mortality declines in less developed countries. The World Health Organization estimates that 80 to 90 percent of rural populations in developing countries have no access to health care. The urban poor are scarcely better off. In Sao Paulo, for example, infant mortality has recently risen, malaria and bubonic plague have reappeared, and meningitis reached epidemic proportions in 1974.[32] Experience with community-based health systems in a growing number of countries such as Colombia, Jamaica, and particularly China shows that expanded use of paramedical personnel trained to perform routine health services can help meet some of the need. But unless population growth can be slowed, this approach will still leave vast unsatisfied health requirements.

Though rapid population growth puts pressure on public services, the experience of Sri Lanka demonstrates that special efforts to make such services available to all of a developing country's people can actually help lower that growth. Sri Lanka launched a family planning program in the mid-1960s, but much of the sharp fall in its birth rate

Figure 10. Percent of Boys and Girls Enrolled in School: Developed and Developing Countries, 1960-2000



Source: Magda Cordell McHale and John McHale with Guy F. Streatfeild, *Children in the World* (Washington, D.C.: Population Reference Bureau, 1979), p. 56, based on data supplied by UNESCO Office of Statistics.

Note: Developed countries include all of Europe, U.S.S.R., Japan, U.S., Canada, Australia, New Zealand, Argentina, Chile, Uruguay. Developing countries include all others.

from 33 to 26 per 1,000 between 1965 and 1977 is attributed to rapid improvements in education, health, and nutrition which resulted not from gains in per capita income, which remains at a low $200, but from the country's heavy emphasis on mass-oriented social expenditures.[33]

Food

Since World War II, food production worldwide has increased at a slightly

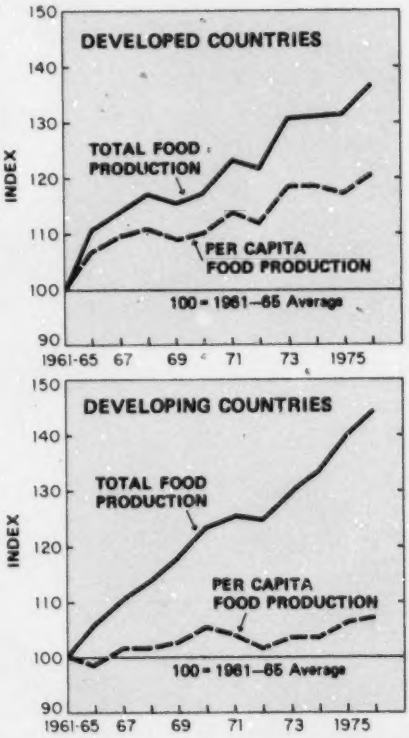
faster rate than population. But most of the improvement in food supply *per person* has been in the already well-fed industrialized countries.

From 1961 through 1976, developing countries as a whole improved food production at a faster rate than developed countries, but because of rampant population growth, their per capita food output grew at a much slower pace (Figure 11). The gain in per capita food production averaged a steady 1.4 percent in industrialized countries during this period. In developing countries, by contrast, annual per capita gains were already below 1 percent in the 1960s and nearly vanished in the early 1970s when droughts slashed yields across Asia and Africa. With better weather, expanded irrigation, and other investments, agricultural production has since improved in the developing world, particularly in Asia, but the situation remains precarious. In India, for example, the 20 million tons of grain reserves collected during four years of good harvests are expected to be drawn down heavily following 1979's late and erratic monsoon rains and poor harvest.[34]

Average per capita food intake in the developing world in 1972-74 was about 2,210 calories a day, compared to 3,380 in the industrialized countries. A 1977 U.N. Food and Agriculture Organization (FAO) survey found that in 44 developing countries per capita daily calorie supplies actually declined between 1961-63 and 1972-74.[35]

The developing world's low *average* intake figure fails to reveal the depth of the problem. Their starchy diet, made up mostly of grains and tubers, is less nutritious than the daily fare of developed countries. And the impoverished majority of people within developing countries fail to get as much as the average indicates since the wealthier get more. The FAO estimates, conservatively, that 455 million people in the developing world in 1972-74 were chronically undernourished, that is, failed to get enough food to "lead a full, healthy life." This was up 54 million over 1969-71, "largely because of population growth."[36] Surveys indicate that "up to 50% of all young children in the developing world may be inadequately nourished"—a deprivation likely to lead to lasting physical and mental damage for those

Figure 11. Total and Per Capita Food Production: Developed and Developing Countries, 1961-65 to 1976



Source: Food and Agriculture Organization of the United Nations, *The Fourth World Food Survey*, 1977 (Rome: 1977) Figure 1.

Note: Developed countries include all of Europe, U.S.S.R., Israel, Japan, South Africa, U.S., Canada, Australia, New Zealand. Developing countries include all others.

who survive. Many do not survive. Malnutrition-related deaths among children under age five may run as high as 10 million annually, according to a World Bank estimate.[37]

If the developing world's population continues to grow by 2.1 to 2.2 percent a year, the FAO estimates that food supplies available to them must rise by at least 4 percent annually if the "calorie deficit" is to be made up by 1990. To do this will require either massive imports of food or greatly stepped-up agricultural production. Meeting the deficit through imports, sources of which cannot be assured, will force many of the developing nations deeper into debt and limit their ability to finance other capital costs of development, including expanding food production. And even if the imported food and funds are somehow available, equitable distribution and physical movement of the enormous grain tonnages involved in feeding hundreds of millions of people will present tremendous problems.[38]

For a time during the 1960s and early 1970s, much hope for increasing agricultural production was placed in the use of better cultivation methods and especially use of higher yielding strains of wheat and rice—the "Green Revolution." But when introduced to less developed countries, the Green Revolution has proven to carry with it a host of problems. In the words of Paul and Anne Ehrlich:

> "There are serious obstacles to establishing the new technology among small, poor farmers—who grow most of the food in LDCs and who most need help. These socioeconomic problems and the vulnerability of the high-yield monoculture crops to climate changes, water and fertilizer shortages, and pest outbreaks may render the high yields less dependable than present harvests."[39]

Many observers note that, like the high agriculture yields in the developed world, the Green Revolution "miracle grains" take tremendous amounts of energy for irrigation, fertilizer, and mechanized inputs. As cheap energy becomes less available, particularly oil and natural gas, the possibilities of increasing food production in developing nations will be diminished.[40]

Norman Borlaug, who received the Nobel Prize for Peace in 1970 for his work in developing the miracle grains, claims that "producing more food and fiber and protecting the environment can, at best, be only a holding operation while the population monster is being tamed." In a 1979 address he noted that to feed the 4 billion people who would be added to the world's current 4 billion in the next 40 years if growth were to continue at 1.8 percent a year, global food and fiber production would have to be increased during that 40 years by more than it had increased during the entire 12,000 years since the dawn of agriculture.[41]

Increasing acreage devoted to food production faces similar formidable problems. Most of the world's well-watered arable land is already under cultivation. The potentially tillable land left, mainly in Latin America and Africa, would require huge investments for special care of tropical soil or supplementary water supplies in arid regions. Meanwhile, "millions of acres of fertile farmland are lost each year because of the growth of cities, erosion, formation of deserts, salinization, overgrazing, and poor management. The U.N. Environment Programme sees twice as much land being lost to these factors by the end of this century as the amount expected to be brought into agricultural production. The U.S., the world's major grain exporter, currently loses about one million acres of prime farmland each year to urbanization and other uses, according to the Council on Environmental Quality.[42]

Minerals and energy

In the past two decades, much has been written about an inevitable "collision" between finite global resources of minerals and energy and spiraling popula-

World Bank photo by Jaime Martin

Stacking grain in Guatemala. A host of problems have dimmed the Green Revolution's promise for increasing agricultural production in developing countries.

tion growth in developing countries, coupled with high consumption in developed countries.[43] In these circumstances, it is claimed, developing countries as a whole could never hope to catch up with the developed nations' living standards of the 1970s, let alone the levels those nations might attain sometime in the future.

Others have offered a somewhat different view. This was discussed by Resources for the Future researchers Ronald Ridker and Elizabeth Cecelski in the August 1979 *Population Bulletin*, "Resources, Environment, and Population: The Nature of Future Limits."[44] For the near term, they see the problems to be faced as "associated less with physical exhaustion of resources than with their unequal distribution and the transition problems of moving from one resource regime to another in an orderly fashion. . . . Poverty-stricken countries and impoverished groups within countries can only be helped by lifting the barriers to the flow of resources, knowledge, and technical and managerial skills into, and/or people, out of these regions."

For the long term, they believe that "there is no danger that the world will 'run out' of minerals as a whole." Minerals and materials like aluminum, plastic, and glass from "virtually inexhaustible sources" can substitute for less abundant minerals like tin, tungsten, and lead, "provided that sufficient energy is available at reasonable cost, both economic and environmental." As for that energy, Ridker and Cecelski agree, like most observers, that the world's prime sources of energy of the past 25 years—oil and natural gas*—will be essentially exhausted sometime after the turn of the century. In the coming decades, coal, oil from shale and tar sands, and nuclear fission—if its safety problems can be resolved—can play an increasing role. Over the long term, solar energy in its various forms and possibly nuclear fusion can provide sources of renewable or "virtually inexhaustible" energy, they say. These new sources of energy could be expensive, they warn, although the costs can be expected to come down as their development proceeds.

Ridker and Cecelski's analysis is based on a projected stable world population of about 10 billion—a billion below the current U.N. "medium" projection for the early part of the 22nd century. However, they assert that a slowdown in population growth rates is important in buying time with which to find solutions.

A slowdown in economic growth or resource consumption can buy equally valuable time to make adjustments. However, Ridker and Cecelski point out that an economic slowdown would reduce the trained manpower and capital available to work on the world's resource problems. It could also frustrate developing countries' legitimate aspirations for a decent level of living as inter-

*Surprising as it may now seem, it was only between 1955 and 1960 that oil and natural gas, taken together, began to account for more than 50 percent of total world consumption of commercial energy. Coal still accounted for nearly a third of the total in 1975.[45]

national markets for their products and capital for investment dry up. This could intensify the dangers of the growing polarization of economic and political relations between developed and developing nations along "North-South" lines.

Economic growth is likely to be slower in industrial countries in any case in the coming decades, due largely to higher energy prices forced by oil producers and the cost of developing substitutes. This is likely to slow development aid, according to the International Finance Corporation, forcing the developing nations to "look increasingly to their own resources and initiatives."[46] Among those initiatives, stepped-up efforts to speed the fertility decline already begun should have prime priority.

Others see danger for the world's resource supplies in both the high consumption rates and continuing, if much slower, population growth of industrialized nations. In 1972, with just over 5 percent of the world's population, for example, the U.S. consumed 32 percent of the world's commercial energy.[47] Thus, since per capita consumption is so high, even the slow rate of population growth in this country may have as deleterious a long-range effect on the world's available resources as the much higher growth of an equivalent population in low-consumption developing nations.

WHO photo by P. N. Sharma

A meager day's fish catch in India

Environment

Even more critical for future generations than rising demands for mineral and energy resources may be the growing pressure of population on the global environment.

In recent decades, the earth's vegetation cover (croplands, forests, and grasslands), fisheries, water sources, and atmosphere have undergone a sharply increased rate of depletion and pollution.

A large part of this is again due to high production and consumption lifestyles, coupled with still-growing populations, in industrialized countries. Environmental degradation has also resulted from the desperate efforts of rapidly growing impoverished populations in developing nations to survive. Vast areas of Africa, South and Southeast Asia, the Middle East, and Latin America have been crippled by slash-and-burn agriculture, overcropping, overgrazing, and consequent wind and water erosion. Ever-growing needs for cropland, firewood, and timber have reduced the world's forest coverage from a quarter of the total land surface 25 years ago to one-fifth today and a projected one-sixth in 2000.[48] Deprived of water-holding cover, millions of tons of virtually irreplaceable topsoil have been washed into the sea.

The problem worldwide is evident in:[49]

- The destruction of vegetation, the source of food and oxygen;
- The leveling off of the world's annual fish catch since 1970 despite stepped-up efforts, due largely to overfishing and pollution of spawning beds;

- Overcrowding and impairment of national parks, wildlife preserves, beaches, and other natural recreational areas;
- Destruction of animal and plant wildlife essential to a healthy ecosystem by farming, timbering, urbanization, pesticide and fertilizer poisoning, and hunting;
- An increase in illnesses such as emphysema, stroke, parasitic infections, heart disease, and cancer caused in part by the introduction of new chemicals into the ecosystem by air and water pollution;
- Water shortages due to the massive water requirements of modern agriculture, mining, industry, and consumer living; depletion of underground water supplies; pollution of lakes and rivers; exhaustion of promising water catchment and irrigation sites; and increasing acidity of rain;
- Damaging rainfall and temperature pattern changes brought on by increasing carbon dioxide in the atmosphere from the burning of wood and fossil fuels, dust from urban and agricultural activity, and the thermal effects of waste heat and economic activity.

This environmental loss and damage is occurring in a world of 4 billion people. In 20 years, the number of human consumers and polluters is expected to be around 6 billion and still growing.

Public awareness of environmental deterioration has grown enormously in the past decade, especially in industrialized countries where pollution from automobiles and industry is most obvious. But despite the passage of increasingly stringent antipollution regulations, the U.S. and other industrial countries are moving less rapidly than they might to control their environmentally destructive lifestyles. In the developing countries, where funds for conservation and antipollution measures are scarce and dependence on natural resources for survival is heavy, more determined efforts to slow population growth would be a key contribution to their own and the world's efforts to preserve the environment.

U.S. Bureau of Land Management

Stripmining in Montana.

World Response to the Problem

Over the past ten to 15 years, there has been an encouraging increase in world awareness of population problems. Many developing countries have seen the need for urgent action to reduce rapid population growth if their development efforts are not to be greatly impaired or totally frustrated. In 1960, of *all* countries in the world, only India and Pakistan supported organized family planning programs, both for the avowed purpose of reducing birth rates. By 1978, 35 less developed countries—with 77 percent of the developing world's population—had official policies to reduce population growth. Another 30, with 15 percent of LDC population, supported family planning programs for other than demographic reasons. Only 7 percent of the developing world's people lived in the 66 nations that have no family planning activities.[50]

By 1976, according to an International Planned Parenthood Federation (IPPF) survey, $670 million was being spent annually on family planning program support by LDC governments themselves and another $314 million was provided

to developing country programs by the U.N. Fund for Population Activities (UNFPA), IPPF, the World Bank, numerous private foundations, and at least nine governments of the developed world.[51] U.S. assistance, administered through the Agency for International Development (AID), provided two-thirds of the $2.1 billion total external assistance over the 1965-78 period, either directly to the countries concerned or indirectly through programs sponsored by private organizations and intermediary agencies such as IPPF and UNFPA.[52]

Family planning "versus" development

Family planning programs in less developed countries vary widely in quality and effectiveness. As former Population Council researchers Mauldin and Berelson put it, these programs "range from vigorous and continuous efforts under skilled management to weak and spotty performance under indifferent administration, on down to no effort at all."[53] How much of the recent fertility decline in LDCs can be attributed to these organized programs? Would birth rates have come down anyway as social and economic development increased couples' motivation to reduce family size, in line with the classical demographic transition theory? These questions have been hotly debated in recent years as the world seeks ways to speed fertility decline in an effort to ward off potentially disastrous overcrowding, deprivation, and disorder.

In the studies mentioned earlier, both published in 1978, Mauldin and Berelson and Tsui and Boque attempted answers. They examined the less developed countries' record in achieving progress in social and economic factors which research suggests are associated with fertility reduction: per capita gross national product, urbanization, life expectancy, literacy, school enrollment, proportions of males or females employed off the farm, and rates of infant survival. For the same time periods, they ranked LDCs according to the strength of their family planning programs from the top (expressed public commitment of political leaders) to the bottom (actual delivery of services). Both studies found that family planning program effort had a significant, independent effect in reducing fertility over and above the effect of socioeconomic progress. However, the key finding appears to be, as Mauldin and Berelson state, that "the two—social setting and program effort—go together most effectively. Countries that rank well on socioeconomic variables *and also* make substantial [family planning] program effort have on average much more fertility decline than do countries that have one or the other, and far more than those with neither."[54]

World Bank photo by William Graham

Family planning in Tunisia.

Before these findings were published, the same questions were hotly debated at the 1974 World Population Conference in Bucharest. As noted, many Third World delegates, pointing to the fertility declines that occurred without benefit of birth control pills or family planning programs as the U.S. and Europe in-

dustrialized, argued that "development is the best contraceptive." They put priority on economic aid from richer countries while the U.S. and other delegations from developed countries sought commitments to making family planning services universally available and setting target dates for lower birth rates. In the end, 136 participating governments (excluding only the Holy See) reached consensus on a World Population Plan of Action (WPPA) that, as IPPF Secretary-General Carl Wahren observed in 1979, "put population squarely where it belongs within the broader context of internationally adopted strategies for national and international progress."[55]

The WPPA advocates a philosophy of "population *and* development." Action is urged to both enhance couples' motivation for small families and provide couples and individuals with the information and means to achieve their desired number and spacing of children, a decision which is guaranteed as a "basic human right."

Motivation for small families

At Bucharest and before, it was recognized that the broad economic and social development thought to be necessary before most couples will opt for small families would be a long time in coming for many less developed countries. But research and experience seemed to show that particular elements of development are especially effective in bringing down birth rates. These were listed in paragraph 32 of the WPPA and include the following.

Reduction of infant and child mortality. When parents can be assured that more of their children will survive to adulthood, they generally have fewer "insurance" births. (The new findings on Europe's demographic history and from Latin America today suggest that the relationship between infant mortality and fertility may be more complicated than once thought.)

Expansion of basic education, especially for girls. Studies in Latin America reveal that women who have completed primary school average about two fewer children than those who have not. For both men and women, education broadens views of life's opportunities and potentialities and reduces resistance to social change, including family planning. It also enhances a girl's chances of employment outside the home that give her alternatives to raising a large family. And parents see children in school as having less immediate economic utility but greater long-term earning capacity; this encourages a smaller, well-educated family norm with children better able to care for parents in their old age. Over the long run, motivation for small families should also be encouraged by incorporating population education into school curricula, as is now being done in many developing nations.

Enhancing the status of women. In addition to increasing women's opportunities for education, most observers agree that enhancing the general status of women socially, economically, and politically could contribute more than any other measure to reduced fertility. When women are accorded esteem for roles other than as mothers or unsalaried house and farm workers, the response is very likely to be smaller families.

More equitable distribution of the benefits of economic growth. Typically in developing countries, the upper 20 percent of the population receives about 55 percent of the national income and the lowest 20 percent about 5 percent.[56] A large proportion of the population remains outside the development process. Experience in Taiwan, South Korea, Sri Lanka, and the state of Kerala in India indicates that economic growth is likely to have the most beneficial effects on fertility where the masses share equitably in that growth through increased income, employment, and access to land and health and education facilities. Large numbers of children are then no longer needed for the little they

World Bank photo by Ray Witlin

Literacy class in Upper Volta. Educating girls may be one of the most effective approaches to reducing fertility in developing countries.

can add to family income while young, or later to support elderly parents. The escape from chronic insecurity and deprivation makes long-term planning and individual control over life's choices, including family size, seem more feasible and acceptable. And with more chances to earn and spend money and time outside the family, parents are likely to find material possessions and lifestyles competing with having numerous children.[57]

Raising the age of marriage. Mauldin and Berelson estimated that 35 to 40 percent of the 1965-75 birth rate decline in the developing countries they studied was accounted for by rising age at marriage, especially of women. This appears to be influenced by more education and employment for women and the "drive to improve socioeconomic status," as in Sri Lanka where the average age at marriage is among the highest in the developing world—28 for men and 24 for women. It may also result from direct intervention as in China where the government urges an "optimal age of marriage" of 28 for men and 25 for women in urban areas, and 25 and 23 in rural areas.

Policy in action

Five years later, the "message of Bucharest"—population *and* development—seems to have been absorbed by developing countries and donors in developed countries alike. But a 1978 joint study by the Organisation for Economic Co-operation and Development (OECD) and the World Bank reports that "it is not proving easy to translate the concept of population *and* development into actual operational programs."[58] On the donor side, the World Bank is trying to introduce population "components" into its projects in other development sectors. AID has been mandated by the U.S. Congress to examine the likely "population impact" of all new development activities and to stress areas, such as education, likely to encourage reduced fertility. But, as in pre-Bucharest years, external aid for population programs remains at just under 2 percent of overall development assistance and, aside from the World Bank and

AID initiatives, there seems to have been little deliberate effort to push particular activities in the other 98 percent of development aid simply because of their presumed effect on reducing fertility.

On the side of the developing countries, reports the OECD/World Bank study, "Despite the Bucharest call for development approaches, family planning remains the prime strategy for implementing population policies." The demand for assistance has risen, far outstripping the $120 million budget of the UNFPA in 1979, for example, but that increased demand has been more than ever for "family planning and related population activities of the pre-Bucharest type."

Recent family planning success stories

At the time of the 1974 Bucharest population conference, family planning in the developing world could boast of successes only in the special city-states of Singapore and Hong Kong, or in such countries as Taiwan and South Korea where fertility had started downward before government programs began and where there was considerable socio-economic development. It was not clear that family planning programs could trigger the transition from high to low birth rates in other countries which did not enjoy similar economic progress. But since then, several family planning program success stories have demonstrated that much can be achieved in circumstances that appear far from ripe ground, as judged by classical demographic transition theory. If these successes can be repeated elsewhere, the prospects for accelerated fertility decline in the coming decades could be much improved.

Chief among these successes is China, with a per capita income of about $410 and a huge agrarian population only 30 years removed from age-old traditions of large families. With over a fifth of the world's population at some 960 million at the end of 1978, what happens in China has enormous bearing on the future size and growth rate of the world's population. According to recent government statistics, China's birth rate at the end of 1978 was down to 20; its death rate was 8; and the rate of natural increase was thus 12 per 1,000, or 1.2 percent.[59] This was equal to the U.S. rate of natural increase in 1964.

The elements of China's success include community-based, free provision of all birth control methods, including sterilization and abortion, by teams of trained, local "barefoot doctors," one of which is always a woman; locally planned and implemented birth quotas; and attempts to integrate women fully into all aspects of society.

On June 18, 1979, Premier Hua Kuofeng declared to the National People's Congress that the government now aims for a natural increase rate of 1 percent in 1979; 0.5 percent by 1985; zero growth by 2000; and, over the long run, a negative growth rate that will reduce the absolute size of the total population. In pursuit of this ambitious goal, a "birth planning law" is now being shaped to encourage the one-child family. Under discussion are proposals to reward one-child couples with substantial child care subsidies until the child reaches 14, priorities in housing and the child's schooling, and—most important—a generous monthly pension upon the parents' retirement, even for rural peasants who now receive no such benefit.

Another success story is found in the densely packed, overwhelmingly rural and poor island of Bali, Indonesia, where two-thirds of women are unschooled. Here, the birth rate fell from 44 per 1,000 at the end of the 1960s to 28 in 1976 when more than half of eligible couples were using modern contraception—up from virtually no use five years earlier before the government family planning program began. Trained village people distribute pills; IUD insertions are readily available; and household heads

themselves, through the traditional *banjar* (hamlet) councils, monitor contraceptive use.

In rural, tradition-bound Thailand, the Community-Based Family Planning Services, working side-by-side with an increasingly strong government program, in four and a half years brought low-cost, efficient, pill and condom services, manned by part-time local distributors, to villages containing over 16 million people. In some villages, as many as 80 percent of eligible couples now use modern contraception and the national total fertility rate was down to four and a half children per woman in 1977—two children less than in the mid-1960s.

Bangladesh has a slow-moving administrative system, a per capita income of just $90, and 90 percent of women are illiterate. According to a 1976 national survey, only 14 percent of "ever-married" women had ever used contraception. However, by the end of 1977, after only two years of operation, a nationwide social marketing scheme, launched by Population Services International and working through local shopkeepers, was selling 2 million condoms and over 80,000 cycles of pills *every month* at costs amounting to only $1.40 for every "couple-year of protection."

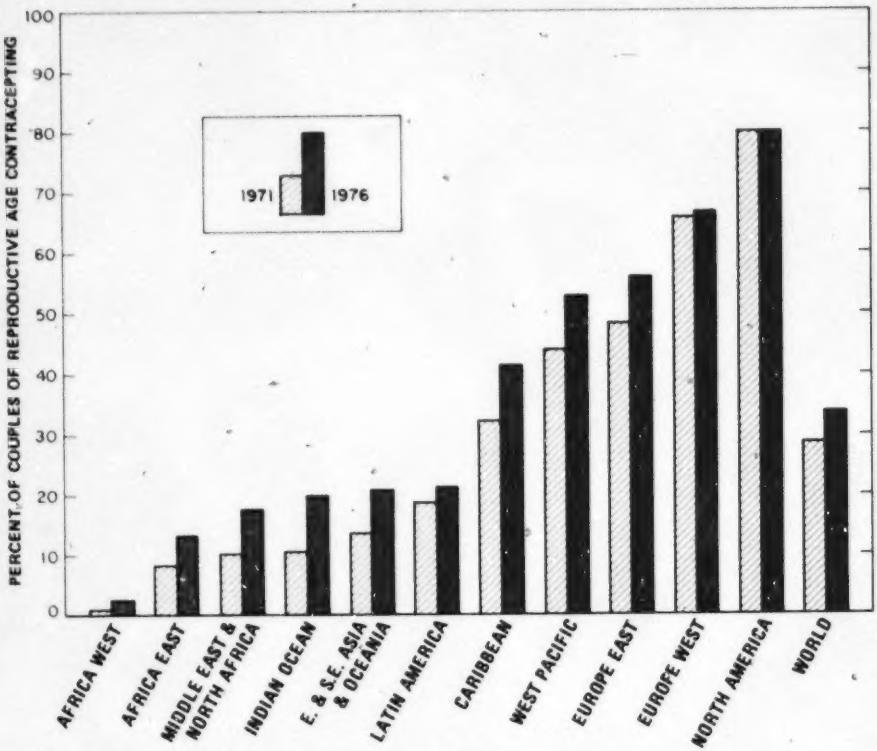
Citing these successes, Malcolm Potts, Executive Director of the International Fertility Research Program, points out their significant factors: access to a full range of effective fertility control methods, including (in China) sterilization and abortion; community involvement; a "realistic use" of paramedics, trained lay people, or local shopkeepers; good management; efforts at self-sufficiency (in Thailand and Bangladesh) with a profit to local distributors and some cash return to the program, even at the very low prices charged to consumers; and, most importantly, resourceful, committed leadership at the top. Potts adds that these successful programs demonstrate that family planning, socioeconomic development, and maternal and child health are "all complementary efforts aimed at improving the quality of human life. Family planning alone can, and sometimes must, make its own direct contribution to health and social progress. But progress will be even more rapid if the fundamental problems of underdevelopment can be tackled from as many sides as the wise management of the limited resources available will allow."[60]

Unmet needs for family planning

Despite specific successes, recent surveys show that family planning still has far to go in the developing world if a massive global population is to be avoided in the future. The International Planned Parenthood Federation (IPPF), in its 1976 Survey of Unmet Needs in Family Planning, found that contraceptive use in over 200 countries taken together had increased only 1 percent a year in the five years since its first such survey in 1971, to reach 35 percent of eligible couples.[61] Contraceptive use was at or below 20 percent in most of the developing world compared to 65 percent and over in developed regions (Figure 12). Moreover, in these five years, the *number* of fecund women worldwide *not* practicing contraception rose from 342 to 361 million, a result of the large numbers of young women entering the childbearing ages. Only half of the world's couples of reproductive age were estimated to have sufficient knowledge of contraception to plan their families. The IPPF report indicated that contraceptive knowledge and practice would have to increase at a much faster pace if the world is to reach even the average family size of just under four children that would be required by 2000 in order to achieve replacement-level fertility about 2045 and a stabilized world population of 15 billion by the year 2100 (see high projection in Figure 6, page 15).

Particularly worrisome was the low level of young people's exposure to education that could change family-size

Figure 12. World and Regional Contraceptive Practice Levels: 1976



Source: "International Planned Parenthood Survey of Unmet Needs in Family Planning in 1976, reported in *People*, Vol. 5, No. 2 (London: International Planned Parenthood Federation, 1978) p. 27. Reproduced with permission.

attitudes and encourage accelerated contraceptive use in the generation that will most affect global fertility levels in the coming decades. Estimates for countries outside North America and Europe showed that three-quarters of children under 15 and more than half of youths over 15 still had no access to sex education programs, in school or elsewhere. And in most countries, almost two-thirds of young people had no access to contraceptive methods.

The survey also documented increasing acceptance of sterilization worldwide and abortions running at about 34 million a year, or about one abortion for every three live births in 1976. This figure was down from an annual 55 million abortions estimated in IPPF's 1971 survey. Estimates of illegal abortions came to about the same proportion of the total, despite increasing liberalization of abortion laws in the five years between the surveys.

Findings from the first 15 countries to report in the World Fertility Survey (WFS) indicate that although most women in developing countries now know of

Table 3. Contraceptive Knowledge and Use: World Fertility Survey Findings from 15 Developing Countries, 1974-1977

Country (year of survey)		Percent of ever-married women who have heard of a contraceptive method	Percent of ever-married women who have used a contraceptive method
Asia and Pacific			
Bangladesh	(1976)	82	14
Fiji	(1974)	100	68
Indonesia	(1976)	77	34
Malaysia	(1974)	92	46
Nepal	(1976)	22	4
Pakistan	(1975)	75	10
South Korea	(1974)	97	57
Sri Lanka	(1975)	91	43
Thailand	(1977)	96	45
Latin America			
Colombia	(1976)	96	59
Costa Rica	(1976)	100	82
Dominican Republic	(1975)	97	47
Mexico	(1976)	80	45
Panama	(1976)	98	73
Peru	(1977)	82	49

Source: Sir Maurice Kendall, "The World Fertility Survey: Current Status and Findings," *Population Reports*, Series M, No. 3 (Baltimore: Population Information Program, The Johns Hopkins University, July 1979), Table 13.

Note: The World Fertility Survey is a series of surveys that will eventually cover more than 400,000 women in more than 40 developing countries and 20 developed countries. Funded by the United Nations Fund for Population Activities and the U.S. Agency for International Development, it is being conducted by the International Statistical Institute in collaboration with the United Nations and the International Union for the Scientific Study of Population.

at least one contraceptive method, the gap between knowledge and actual practice remains large (Table 3). The most startling contrasts occurred in Bangladesh and Pakistan. In both countries, over 75 percent of ever-married women surveyed knew of contraception but only 14 and 10 percent, respectively, reported ever having used it. In Nepal, 22 percent knew of contraception but only 4 percent had used it. All three countries have national family planning programs but, at least up to 1976, these government programs had evidently been unsuccessful in effectively delivering services and supplies, and in Nepal, information as well.

The WFS findings point up another gap: between the desire to stop childbearing and use of an effective contraceptive method (pill, IUD, injection, sterilization, or condom). About half of the married women surveyed in the 15 countries reported wanting no more children, but about half of this group were not using modern contraception. Accessibility to family planning services helps close this gap. In Nepal, for example, 95 percent of married women who wanted no more children but did not know an outlet for services were not using effective contraception, compared to only 51 percent of those who knew of an outlet within two hours' travel.

The WFS report agrees that socioeconomic changes indirectly and over the long run affect factors like education, age at marriage, and desired number of children that influence couples' knowledge and use of modern contraception. But, like the successes in China, Indonesia, Thailand, and, to a limited extent, in Bangladesh, the WFS findings suggest that, in the short run, contraceptive knowledge, acceptance, and use can be speeded up in the developing world if services are made widely, easily, and conspicuously available. This should accelerate significantly the decline in birth rates recently begun.

The Outlook

What lies ahead? All are agreed that the world's present growth rate of 1.7 percent, which would double human numbers in just 41 years, cannot continue indefinitely. It is also clear, however, that—barring a nuclear holocaust or massive famine—a much larger population lies ahead for the developing countries and the world as a whole. With close to half of the developing world's

population now under age 15, the relentless arithmetic of population momentum will carry waves of population growth into the 21st century even if replacement-level fertility—essentially, an average family of two children—were miraculously to be achieved everywhere tomorrow. Just when Earth's population will stop growing and how large it then will be depends crucially on when that worldwide replacement-level fertility is reached. As World Bank President Robert McNamara recently pointed out: "For every decade of delay in achieving . . . replacement-level fertility—the world's ultimate stabilized population will be about 11 percent greater."[62]

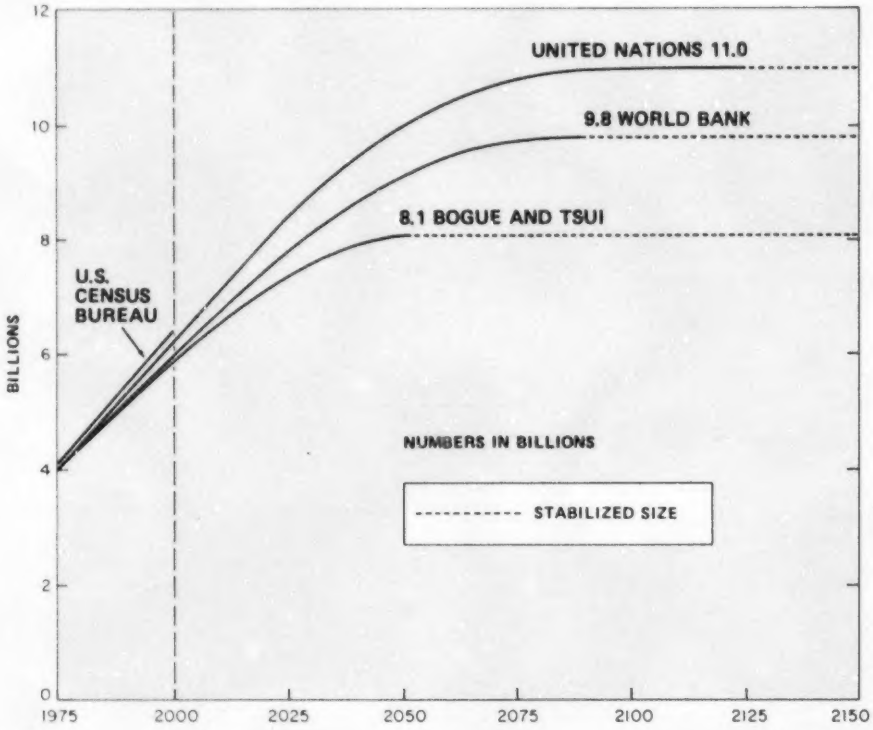
Current "medium" projections for world population in the year 2000, just around the corner, range from a low of 5.9 billion (Bogue and Tsui) to a high of 6.4 billion (U.S. Bureau of the Census)—a difference of "only" half a billion. For further into the future, demographers' opinions vary much more widely as seen in Figure 13 (page 38). Bogue and Tsui predict a rapid slowdown to zero growth and a peak global total population of about 8.1 billion by 2050, provided that family planning programs are pursued vigorously in the developing world and steady gains in social and economic development continue. The most recently published long-range projections of the United Nations put the peak at about 11 billion about a century and a half from now. World Bank estimates fall in between. "If current trends continue," the Bank projects replacement-level fertility for the world as a whole about 2020 and a stabilized population of 9.8 billion some 70 years later.

All these projections depend chiefly on assumptions concerning the pace of fertility decline in developing countries—a pace that could change with unforeseen events or be made to change with sustained will. China, which claims to have cut its rate of natural increase by half (23 to 12 per 1,000 population) in the seven years from 1971 to 1978,[63] could substantially lower the higher projections of eventual world population if its present goal of a nongrowing population by the year 2000 is indeed reached. Other key developing countries are also showing hopeful signs of more rapid than expected fertility decline. Mexico, the world's 11th most populous country at about 68 million in 1979, is now vigorously committed to reducing population growth after a long history of pronatalism. Recent data suggest that its 1975 birth rate of about 40 per 1,000 was reduced to about 35 only four years later, in spite of the enormous number of young people in the childbearing ages.[64] The figures are similar for Indonesia, the world's fifth largest country at about 140 million in 1979.

On the other hand, despite long-standing national family planning programs, almost no fertility decline has been registered in populous Pakistan (80 million in 1979) or Bangladesh (87 million) and their birth rates are still in the mid-40s. India, with about 660 million people, second only to China's some 960 million, has now put off to the mid-1980s a target birth rate of 30 originally hoped for by the late 1970s; contraceptive acceptance rates plummeted following the over-zealous sterilization drive which helped topple Prime Minister Gandhi's government in 1977. Nigeria, Africa's most populous country at 75 million, is not yet convinced that it has a population problem although family planning is supported on health grounds; its high birth rate of 50 may actually be rising. Brazil, the world's sixth most populous country at 119 million, has also supported family planning for health reasons since 1974 but still views a larger population as economically and politically necessary. Though its birth rate may now be down to about 34, Brazil's population is still growing at a high 2.5 percent.[65]

Worldwatch Institute President Lester Brown doubts that a global population as high as 12 billion (an earlier projection of the United Nations) will ever be

Figure 13. Projections of World Population in 2000 and Ultimate Stabilized Size



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Note: The U.S. Census Bureau has not published projections beyond 2000. The World Bank publishes only one series. The other projections shown are medium series (between high and low variants).

reached.[66] He sees crucial biological systems—fisheries, forests, grasslands, and croplands—and oil resources already showing unsupportable strains at the current 4.3 billion. He predicts that further mounting pressures on vital resources, translated into unemployment, lowered per capita income, and inflation, will force restricted childbearing on individual couples and stabilized population policies on governments that do not now have them. To ward off collapse of the earth's major biological systems, Brown urges a "concerted global effort to slam on the demographic brakes" with the aim of halting population growth just short of 6 billion about 2015. This timetable calls for zero population

growth in the developed world by 1985—a target already achieved by several industrial countries, as Brown points out. For developing countries, he urges an effort to reduce birth rates to 25 per 1,000 population by 1985, down from the present average of 33, followed by a leveling off for two decades while the current bulge of young people already born moves through their reproductive years, and then a final push to bring birth rates into balance with death rates at a low level by 2015. Brown admits that this "exceedingly ambitious" target would be extremely difficult for African countries in particular where birth rates are now between 40 and 50. But the alternative could be the return of the famines that claimed hundreds of thousands of lives across the southern fringe of the Sahara in the early 1970s. And in achieving the target, Brown observes that "No country would have to reduce its birth rate any more rapidly than Barbados, China, Costa Rica, Indonesia, and Singapore already have."

To speed fertility decline

Efforts heroic enough to meet Brown's timetable are probably unimaginable in the two decades remaining to the 20th century. But clearly birth rate declines must be accelerated now in most LDCs if the world is to avoid an eventual population so massive that the future of humanity and its ecological support system would be jeopardized. The approaches currently being pursued or proposed to speed these declines include both efforts to improve family planning services and "beyond family planning" measures to enhance motivation for smaller families. They can be summed up as follows:[67]

More and improved family planning services. Surveys and experience in Asia and Latin America show that readily available, well advertised services can, in many cases, boost contraceptive practice rates dramatically, even in illiterate, rural, poor populations. A current popular call is for "integrating" family planning services into other development efforts—rural development, nonformal education, and especially health. Here, however, they may get short shrift. More promising is expansion of community-based or commercial distribution of contraceptive supplies. New contraceptive methods which women would use for longer intervals than they now do the pill and the IUD could contribute substantially to fertility declines. A vaginal ring, an improved IUD, and long-lasting implants, expected to be ready for general use in the early 1980s, show such promise. Where available, injections—good for three or six months before needing renewal—have proved popular. If sterilization—now the world's leading contraceptive method with an estimated 90 million couples thus protected[68]—and abortion were made easily and safely available in all developing countries, there could well be a substantial impact on birth rates. But these methods remain officially unacceptable in many areas and among some influential religious groups.

Information and education. Over the long run, population education can change family-size attitudes. In the short run, information about contraception, an integral part of most family planning programs, helps spur contraceptive acceptance. Some governments are going beyond this to emphasize the desirability of the two or three child family, and in China, one child.

Restructured development. This is the "message of Bucharest," that is, to push those elements of development that appear to be most directly related to lowered fertility: reductions in infant mortality, improvements in women's status, better education and nutrition, and generally more equitable distribution of the benefits of development. These are all desirable goals in themselves and indeed are already part of development planning in most LDCs.

Incentives/disincentives. Singapore, a pioneer in this approach, with housing, tax, and maternity policies designed to

discourage more than two children per family, has now reduced its fertility to replacement level. Direct payments raised vasectomy acceptances dramatically in India in the early 1970s, but were later abused. Indonesia and other countries are now experimenting with community incentives—offering roads and water supplies, for example, to villages which achieve lowered fertility goals.

Pressures and sanctions. Some observers feel that voluntary family planning, even coupled with measurable gains in levels of living, cannot be expected to reduce LDC birth rates rapidly in the near future because most couples in developing countries, they claim, still *want* large families. Recent World Fertility Survey data do show ever-married women in developing countries reporting that they want one to nearly five more children than the average of about two desired children reported by their counterparts in Hungary and Japan, for example. Even in the U.S., however, desired family size averaged a relatively high 2.7 children among ever-married women aged 15-44 interviewed in the 1976 National Survey of Family Growth (Table 4). People concerned about the apparent gap in developing countries between desired family size and replacement-level fertility argue that closing the gap may take politically organized peer pressure, as in China. In some developing countries, they say, it may take stronger pressures and penalties such as those tried or proposed in India during the sterilization drive of 1976-77, although these backfired. Such measures appear unethical to many people in developed countries, although it is conceded that government restraints on individual freedom in the interest of the common good are accepted in other demographic areas such as age at marriage, international migration, and vaccination. To those who decry government pressure to reduce fertility, the proponents of this approach counter with arguments like

Table 4. Desired Family Size: World Fertility Survey Findings, 1974-1978

Country (year of survey)		Average number of children desired by ever-married women
Africa		
Kenya	(1977-78)	6.8
Asia and Pacific		
Bangladesh	(1976)	4.1
Fiji	(1974)	4.2
Indonesia	(1976)	4.2[a]
Malaysia	(1974)	4.4
Nepal	(1976)	3.9
Pakistan	(1975)	4.3
South Korea	(1974)	3.2
Sri Lanka	(1975)	3.8
Thailand	(1977)	3.7
Latin America		
Colombia	(1976)	4.1
Costa Rica	(1976)	4.7
Dominican Republic	(1975)	4.7
Mexico	(1976)	4.4
Panama	(1976)	4.2
Peru	(1977)	3.8
Developed countries		
Hungary	(1974)	2.0
Japan	(1974)	2.2
United States	(1976)	2.7

Sources: Kenya: Central Bureau of Statistics, *Kenya Fertility Survey: Major Highlights, 1977-78*, (Nairobi: Ministry of Economic Planning and Community Affairs, 1979); Hungary: Hungarian Central Statistical Office, *Main Results of the 1977 Hungarian Fertility, Family Planning, and Birth Control Study, TCS-77* (Budapest, 1978); United States: unpublished data from 1976 National Survey of Family Growth supplied by William F. Pratt, Chief, Family Growth Survey Branch, National Center for Health Statistics. Results from this U.S. survey are to be published within the World Fertility Survey (WFS) series. All other data in this table are from published First Country Reports or Summary Reports of the WFS.

[a]Currently married women.

those of demographer Kingsley Davis at the 1978 hearings of the U.S. House of Representatives Select Committee on Population:

"It is patently misleading to believe that fertility can be reduced to replacement levels with no restraints whatsoever by way of incentives and/or disincentives for individual behavior. . . . To endorse absolute voluntarism when it comes to having children is to deny the reality of the harsh consequences on human well-being of high rates of population growth and therefore is neither ethical nor humanitarian."[69]

Although the emphasis may vary with individual country situations, all of these approaches are and will doubtless be necessary if fertility is to decline rapidly to replacement level in the coming two or three decades. The only other alternative to staving off an intolerable ultimate global population size is higher death rates and that choice is unacceptable. Migration to industrial countries has eased population pressure for some small and medium-size developing countries—Algeria, Mexico, Morocco, Tunisia, and Turkey, for example. But international migration on the scale that would be required to make a significant difference for countries the size of India and Pakistan is now impossible. India alone adds 13 million to the world's population every year—the same number currently estimated for the refugees that are now straining the entire free world's absorptive capacities.[70]

The growing awareness of the world's population problem over the past ten to 15 years is encouraging as is the recent slowdown in global growth rates. But in absolute numbers the population explosion forecast by Population Reference Bureau founder Guy Irving Burch is with us more relentlessly than ever. In the 50 years since Burch founded the Bureau, world population has more than doubled. If the current growth rate were to continue, the next doubling would take 41 years. In the eight and a half years since "Man's Population Predicament," the predecessor to this *Bulletin*, was published, the earth has added 640 million people—nearly three more United States. The "new look" at the predicament reported here indicates that worldwide action to unravel the predicament is needed more urgently than ever.

Slowing and eventually halting population growth will not alone solve all of humanity's most pressing problems. Lifestyles will also have to change in the rich developed world and among the affluent elite of developing countries if the absolute poverty of what the World Bank estimates to be 800 million human beings in the developing world is to be relieved; all the world's people adequately fed; North-South tensions eased; energy shortages and attendant inflation and unemployment overcome; and the global environment preserved. But rapid population growth shares the roots of these problems with growing consumption rates, and reducing it is essential to their solution.

The world is already overcrowded at 4.3 billion—in both developed and developing countries—and is destined to become much more crowded. We can no longer avoid a world of at least 6 billion and then, probably, some decades later, 8 billion. But the actions we take now could—and must—avert the even greater stresses, poverty, and hunger that would prevail in a world of 10, 11, or more billions.

Photo by Harold M. Lambert

The Age of Discontinuity

By Rufus E. Miles, Jr.

Rufus Miles served as PRB's President and Editor from May 1970 to September 1971, after having been a Member and then Chairman of the Board of Trustees since 1957. Capping a long and distinguished career with the federal government, he was the senior administrative official of the Department of Health, Education, and Welfare from 1953 to 1965. From 1966 to 1970 he was director of the Mid-Career Program for federal officials at Princeton University's Woodrow Wilson School of Public and International Affairs. Currently, he is a Senior Fellow at the Woodrow Wilson School.

Long concerned with subjects of demographic consequence, Mr. Miles authored several outstanding Population Bulletins, *including "Population Challenge of the '70s" (February 1970) and "The Future Population of the United States" (February 1971), in addition to the predecessor to this* Bulletin, *"Man's Population Predicament" (April 1971). He is also the author of* Awakening from the American Dream *(Universe, 1976).*

The age in which we live has been properly characterized as "the age of discontinuity." Each year it becomes more apparent that the trends of recent decades—in population, energy consumption, and economic growth—are subject to downward shifts that are more abrupt than any that were thought likely a decade or two ago. Projections based on extrapolations of past trends until the end of the century have often turned out to be much in error, almost always on the high side. Projections for several decades beyond the year 2000 based on similar extrapolations, even with moderate downward adjustments, seem even more likely to require marked reduction as the years go by. There seems little doubt that the world is in for a dramatic set of changes in the most fundamental factors influencing the growth of national societies.

American demographers were confounded after World War II by the amazing increase in fertility that became known as the "baby boom," and by its rather abrupt end and conversion into a "baby bust." Fertility dropped in 16 years to a mere half of what it was in 1957, bringing it down so low that by 1973 American women were no longer replacing themselves. The change was so rapid that the Census Bureau's 1956 "low projections" for 1975 became the "high projections" for 1981. Apart from immigration, the population of the U.S. now seems likely to start declining after the children of the baby boom have completed their families.

Sub-replacement fertility is now becoming the norm in the developed world. Many European countries have lower fertility rates than the U.S. and at least two have already reached the point where their populations are declining. This situation was not foreseen two decades ago when most demographers assumed continuing growth in all countries for at least the rest of the century.

Current medium projections of the United Nations, based on extrapolations of recent trends, put global population at the end of this century at 6.2 billion and ultimate world population (around 2125) at about 11 billion when births and deaths are expected to come into balance. Whether U.N. demographers expect world population to stay at this level after that is not clear. But dramatic changes, already emerging, may cause the United Nations to find itself in the same situation as the Bureau of the Census in the 1960s when it had to issue downward adjustments at frequent intervals because of the rapidly changing mores of American women. This is already foreseeable as a result of the demographic earthquake that seems to be occurring in China.

China's attack on population growth

As highlighted earlier in this *Bulletin*, Deputy Prime Minister Chen Muhua announced in August, 1979, that China had succeeded in reducing its annual

rate of natural increase from 2.3 percent in 1971 to 1.2 percent in 1978. Thus, China, although still overwhelmingly rural and agricultural, is moving surprisingly rapidly toward the pattern of low birth and death rates characteristic of industrialized and urbanized nations. Not content with its progress so far, China has decided to mount a strenuous campaign to persuade married couples to limit their families to one child and to reduce population growth to 0.5 percent by 1985 and zero in the year 2000. Such a rapid reduction in the rate of population growth would appear to be unobtainable, but the very magnitude of China's effort to halt its population growth is indicative of a profound and sudden change in the reproductive mores of more than one-fifth of the human race.

The psychological impact of China's remarkable slowdown in population growth may well result in a significant change in official attitudes and policies in many of the developing nations. Until quite recently, the Marxian doctrine that population growth could never be a problem in a well-organized Marxist state was the guiding dogma of China and almost certainly had significant influence on other nations of the developing world. Now that doctrine has been jettisoned by the world's largest nation, presumably on the ground that it has been proven invalid. If it is invalid for China, and if China makes a concerted and continuing effort to reduce fertility to sub-replacement levels, the example can hardly fail to have effect elsewhere.

It can hardly be expected, however, that other developing nations will be able to achieve such rapid birth rate reductions as China has. The levels of education and social discipline in China are higher than in almost all nations that now have high rates of population growth. Moreover, it seems unlikely that even China will long pursue the one-child family goal, since the distortion of the age distribution would become extreme. China would face the unhappy prospect of a very small generation of workers supporting a huge group of oldsters. Nevertheless, China's turnabout in family planning policy now makes it seem likely that the U.N. projection of an ultimate world population of about 11 billion early in the 22nd century will be revised downward in the not distant future.

Photo by Jessie Harris

Boys at the Ming Tombs in Peking. China's drive for a drastic slowdown in population growth could reduce current projections of the world's ultimate stabilized population size.

Does this mean that the prospect of famine, severe malnutrition, and other manifestations of dire poverty will be correspondingly reduced? In some degree, perhaps, but the radically changed energy picture makes it even more urgent that birth rates be sharply reduced in the developing world. The brevity of the era of plentiful and cheap petroleum and natural gas—the second major manifestation of the age of discontinuity—has been gradually sinking into the consciousness of the American people and the rest of the world. The ending of this era will clearly make it much more difficult to lift the living standards of the billions of people in the developing world who are still increasing in number by more than 2 percent a year.

End of the petroleum era

Until the early 1970s, Americans could see no near-term limit to the productivity of their oil or gas wells. The U.S. Geological Survey was estimating ultimate petroleum reserves in the "lower" 48 states of 500-600 billion barrels, enough to last for many decades even assuming a considerable growth in consumption. A lone geologist and geophysicist, Dr. M. King Hubbert, then working for the Shell Oil Company in Houston, Texas, had predicted as early as 1956 that oil "production" (the proper world should be extraction, but it is never used) in the lower 48 states would peak near the end of the 1960s and thereafter begin to decline at an accelerating pace, but nobody paid attention. The peak actually did occur in 1970, but the U.S. Geological Survey was still euphoric about the prospect of great new oil discoveries. It regarded Hubbert's estimate of roughly 165 billion barrels as a gross underestimate of U.S. oil reserves in the lower 48 states. In the nine years since the decline set in, however, Hubbert has become something of a minor prophet and the U.S. Geological Survey has had to reduce its estimates by more than half. (It is worthy of note that Hubbert served as a trustee of the Population Reference Bureau from 1966 to 1972.)

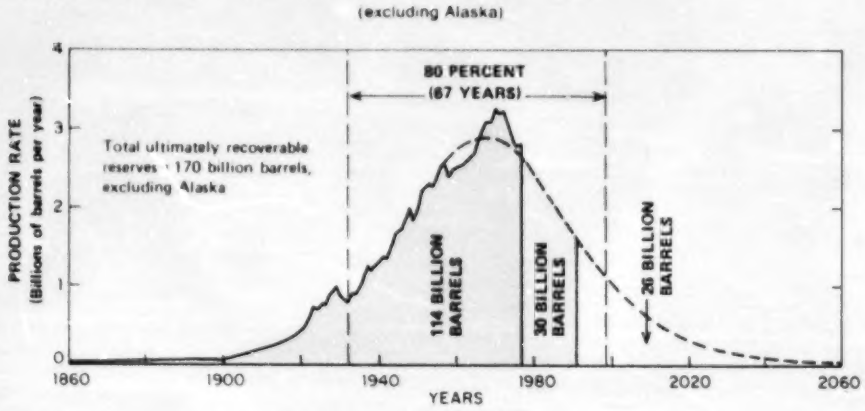
Hubbert based his estimate of U.S. oil reserves (excluding Alaska), and his prediction as to when the peak of production would be reached, on the cassic bell curve. With it, he estimated that the U.S. would consume the middle 80 percent of its total oil deposits of liquid petroleum (outside Alaska) in the 65-year period from 1934 to 1999. He used the same methodology in respect to world oil supplies and concluded, on the basis of somewhat less reliable data, that the middle 80 percent of the world's oil would be consumed in 58 years from 1965 to 2023, with the peak of production being reached between 1990 and 2000.

Hubbert has since revised these estimates slightly. For the U.S., based on data to 1979, he increases his estimate of the ultimately recoverable crude oil reserves for the lower 48 U.S. states to 170 billion barrels with the time frame for production of the middle 80 percent extended to 67 years, 1932 to 1999 (Figure 14). Adding in Alaska oil reserves of about 35 billion barrels increases the U.S. total to 215 billion barrels but extends the time frame for only a few more years. For the world as a whole, Hubbert suggests that, for political and other reasons, oil production might stagnate at the current 20 billion barrels per year. If that were to happen, the "middle-80-percent-production" span could be extended to 2056.[7]

In all cases, and even allowing for a fair margin of error, the brevity of the petroleum era is self evident.

One remarkable feature of the petroleum era has been the extraordinary cheapness of energy derived from oil and the consequent speed with which American civilization has structured itself on the assumption that petroleum and its derivatives would always be cheap and plentiful. Even so recently as the beginning of World War II, the man-built features of the U.S. were astonishingly different from what they are today. Cities had no freeways, no circumferential highways, no supermarket shopping centers, few suburbs that were not reachable by mass transit, few commercial airplanes and airports, and an abundance of electric streetcars and railroad passenger trains. Over 43 percent of the people lived in rural areas. In the 39 years since 1940 the country has so completely restructured itself that a person who cannot afford an automobile, or would prefer to live without one, is more of a social cripple in most parts of the U.S. than a paraplegic with a specially fitted automobile. Our society has built itself on the assumption of the universal use of the automobile and the continued availability of cheap gasoline. What will happen to this society when the supply of oil falls further and further

Figure 14. Complete Cycle of U.S. Crude Oil Production: King Hubbert Estimate, 1979



Source: M. King Hubbert, Consultant, Washington, D.C. 20016, unpublished updated estimate, 1979

behind the demand? This question will lie at, or close to, the center of American consciousness for the rest of the century.

Hard as it will be for most Americans to learn to readjust to the approaching end of the era of cheap petroleum, its impact on the developing nations will be harder still, and by a substantial margin. They had counted on being able to increase their purchases of oil to help them not only to industrialize but also to increase their agricultural productivity. Those that lack exportable resources or products with which to purchase high-priced oil, and lack the capacity to purchase capital equipment that would enable them to compete in international markets, will find it increasingly difficult to maintain existing levels of living for populations growing at 2 to 3 percent a year, let alone improving their diets and other elements of an increased level of living. The problem is further compounded by the severe maldistribution of wealth and income within many of these countries. The energy problem is clearly making the population problem more acute.

Unfortunately, as the price of energy goes up and as the American consumer finds himself in a tighter and tighter price squeeze, foreign aid to the less fortunate nations seems likely to have low priority within the nation's budget. Cries for a more equitable economic order for the world will probably fall on deaf ears among the voters and the Congress. Conceivably, other international cartels than OPEC (Organization of Petroleum Exporting Countries) might succeed for a time in raising the prices of raw materials or agricultural exports of nations that join together to form a cartel, but the prospects of success seem dim. In these cases, unlike oil, other materials and products can usually be substituted rather rapidly if prices are boosted too high. In the end, hard and unjust as it may seem to the developing nations, most of them are going to have to rely primarily on indigenous solutions to their race between population and resources.

Among the options open to them is the adoption of nationwide programs of education, incentives, and strong encouragement toward small families on a

much more concerted basis than those conducted by most of them so far. Failure to proceed in this manner seems likely to result in more severe malnutrition than already exists, and will almost certainly bring on periodic famines in various countries. The oil crisis should bring one nation after another to a realization that there is no escaping the need to bring births and deaths into balance at the earliest possible date. The realization of the human population predicament and effective action to cope with it by the developing world may change reproductive mores more rapidly in the 1980s than most demographers have heretofore thought at all likely.

Within such a world context, Americans are faced with the moral imperative and the practical necessity to reduce rapidly their profligate consumption of the remaining reserves of the world's precious petroleum. A concerted and continuing program of oil conservation will be of more value in the long run to the developing countries of the world than billions of dollars in foreign aid. Simultaneously, it will curb inflation and improve national security. And it may well stave off or reduce the severity of future famines in parts of the developing world.

Barring a nuclear holocaust, the children of the baby boom, who also happen to be the children of the petroleum binge, should live to see the end of the population explosion. They will live to see the extent to which human beings and human societies are able to use their allegedly superior intelligence to adjust to a very different world than one of unending growth. It will be a supreme test of human wisdom. □

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